

UDC 338:502:658.8

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## REVERSE LOGISTICS IN A SYSTEM OF THE CIRCULAR ECONOMY: THEORETICAL ASPECT

**Problem statement.** At present, against the background of the rapid development of the circular economy in the context of globalization and integration, the issues of protection and preservation of the environment are of great importance. This was noted in the global Agenda in the field of the development for the period up to 2030, adopted at the Summit on sustainable development in September 2015. This is indicated in the UN «Sustainable Development Goals for 2016-2030», the implementation of which requires an innovative approach to the green transformation of the economy and monitoring [1, p. 7].

Ensuring sustainable development requires the implementation of organizational and management and environmental technologies adequate to transformation of the economy, as well as modern innovative forms of waste management. This is in line with the green growth concept proposed by the Organisation for Economic Cooperation and Development.

As international best practices show, increase of the efficiency of the industrial production can be achieved through the implementation of conceptually new management tools, which are based on the principles of logistics, namely the system and process approaches, the concept of «lean» production, «rust in time».

The generalization of scientific developments is the evidence of the prospects and expediency of the development of a new concept of logistics – reverse logistics, which should consist in the use of waste as a secondary resource in order to achieve cost-effective and environmentally safe processing.

Therefore, it is necessary to apply the principles and tools of reverse logistics to solve the problems of rational waste management. This will improve the logistics management of waste due to the effective organiza-

tion of logistics processes (warehousing, transportation, storage, recycling), continuous monitoring and control of the movement of material, information and financial flows of waste, the growth of financial resources of enterprises, improving the quality of logistics services, the formation and development of logistics infrastructure, coordination between the participants of the logistics chain.

**Analysis of recent publications on the problem.** Nowadays leading scientists hold scientific discussions on the implementation of the concept of green growth in order to preserve the environment and improve the economic activities of enterprises using environmentally friendly and logistics technologies. At the same time the request of enterprises to form an environmental image among consumers contributed to the development of the concept of sustainable logistics, which includes «green» components and considers economic, social and environmental activities in the context of logistics management. According to the researchers, the majority of consumers will prefer companies that use «green» logistics solutions in a short time [2, p. 282]. According to the survey, more than 59% of corporations recognized that environmental transportation will be a key factor for consumers in the future [3].

Based on the analysis of scientific publications the main provisions of scientists and specialists on improving waste management on the principle of the environmentally oriented logistics have been summarized:

concepts of «green logistics» have been defined, its main lines of implementation and development in the context of the business concept of circular economy have been identified [2; 4-13];

system of sustainable management of logistics operations has been formed, which includes reverse logistics [14-21];

it is proposed to apply the logistics approach, which consists in the optimal management of economic flows, reserves and procedure of financial investing in smart city in complex socio-economic systems to achieve the goals with minimal costs [22, p. 400; 23, p. 204; 24, p. 1802];

necessity of formation of environmentally oriented logistics management has been substantiated, its goal is to obtain an integrated ecological and economic effect as a result of optimization of flow processes in the production logistical system, which will reduce the duration of the logistics cycle, improve the environmental quality of products, reduce the loss of resources during storage and transportation and the volume of waste generation [25, p. 8, 9];

features of formation of «green» logistics systems of the city has been determined, which includes reverse logistics system involving the control of movement of waste and includes the processes of waste recycling and disposal [11, p. 216].

Analysis of the special literature on logistics shows a variety of approaches to the definition of the term «reverse logistics». It has been established that this definition is identified with different concepts in scientific sources, such as «green logistics», «environmental logistics», «reverse environmental logistics», «reverse logistics», «environmental logistics in the recycling system», «waste logistics», «reverse flow logistics», «logistics of resource saving», «logistics of waste recycling», «logistics of waste management», «logistics of waste processing and storage», «sustainable logistics», «green marketing», «reverse marketing», etc.

Due to a large number of formulations of the definition «reverse logistics», it became necessary to systematize them in order to clarify the essence and content. This determined the choice of the topic of this study.

Thus, **goal of this research** is to develop further the theoretical provisions and clarify the conceptual framework of the essence and content of the term «reverse logistics» as an effective tool for waste management in economic activity.

**Outline of the main results and their justification.** The term «green logistics» emerged in the early 90-s of the XX century as a new method of logistics which adapts the standard logistical requirements of rationality, efficiency and speed of processing and movements of goods and takes into account measures for the protection of the environment [7, p. 88].

Studying the content of the term «green logistics», it is found that there are different approaches to its interpretation:

environmentally acceptable and efficient transport distribution system [8, p. 340];

scientific line and one of the factors of the environmental conservation based on resource-saving and environmentally safe processes and technologies [26, p. 53];

the line, which provides a holistic transformation of logistics strategies, processes, structures of all parti-

cipants in the supply chain in accordance with resource-saving, energy-efficient and environmental technologies and aims to achieve a balance between economic and environmental efficiency [27, p. 32];

set of logistics approaches to optimize the movement of material flows (including waste and secondary resources for processing), vehicles, natural, financial, information, energy and human resources with the use of advanced technologies in the decision-making process of local governments in order to create an environment where the needs of the population are met, the efficiency of urban production is increased and the condition of minimizing the negative consequences of anthropogenic interference in the ecosystem of the city is achieved [28, p. 163];

logistics, which is based on resource-saving and environmentally friendly technologies [13, p. 87; 29, p. 43];

from the standpoint of ensuring environmental safety of a separate system both for the whole society and for an individual consumer [30, p. 50].

Based on the generalization of scientific sources it has been established that the process of formation and development of the concept of green logistics was not easy. So, J.-P. Rodrigue, B. Slack, C. Comtois determine the content category of «green logistics» enough widely, regardless of the subject and object of research. Within the framework of this concept, logistics activities are limited only to the transport distribution system and should be carried out on environmental principles. Moreover they argue that there are certain inconsistencies between the concepts of «green» and «logistics», as cost-saving strategies often contradict the principles of environmental protection, which usually do not take into account environmental costs [8, p. 341].

Researchers proved in their scientific works [3, 4, 31] that the origin, formation and further structuring of «green logistics» is so intertwined with the logistics principles. In their view the «greening» of logistics activities in future will be an important factor of competitiveness, as most consumers will consider priority companies engaged in transportation be means of «green» transport and use technologies that preserve natural resources.

During study it has been established that a number of scholars have proposed an environmental line for logistics called «ecologic» or «environmental logistics», which indicates the ecological orientation of logistics activities, as well as their objective such as the creation of an integrated ecologic system.

At the same time international and Ukrainian scientific schools interpret the concept of «ecologistics» in different ways, namely:

a new line, which provides for the use of the advanced logistics technologies and modern equipment to minimize pollution and improve the efficiency of logistics resources [6, p. 291];

set of actions related to the assessment and minimization of the environmental consequences of logistics activities, where logistics activities are the cause of negative environmental consequences [9, p. 130];

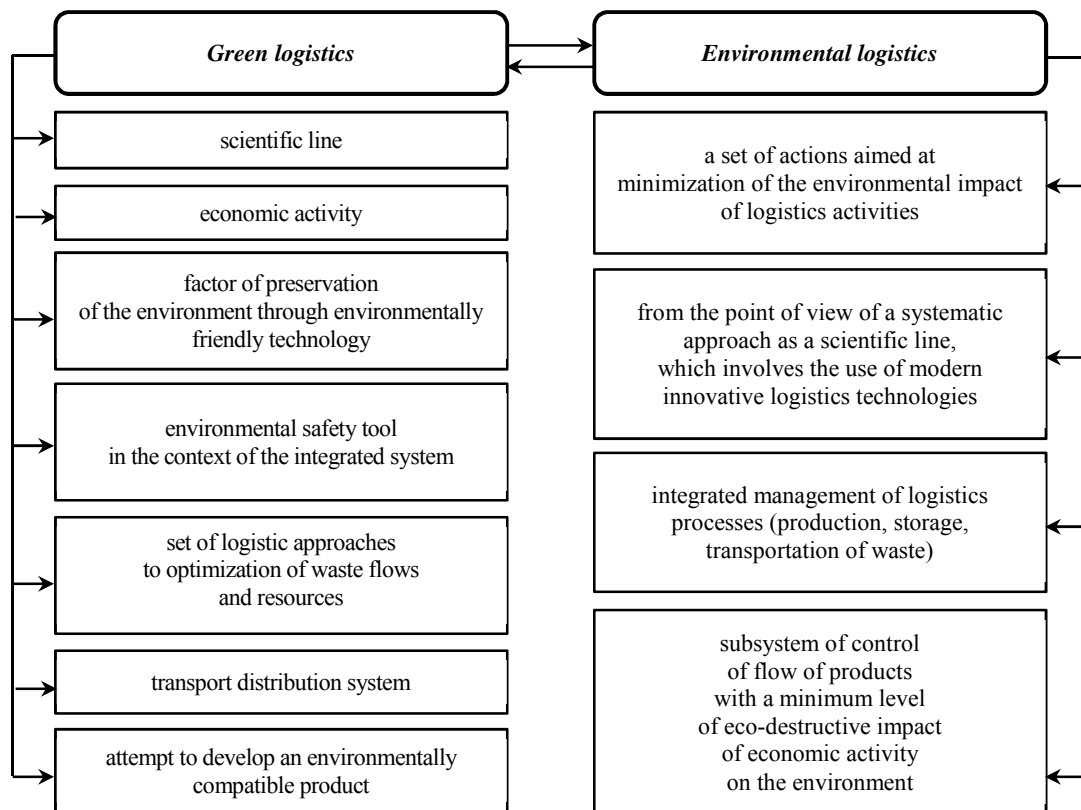
science and a set of measures to ensure the movement of materials in the implementation of all production processes prior to its transformation into a finished product or production waste, followed by the maintenance of waste to disposal or safe storage in the environment, as well as the collection and disposal of waste consumption, its transportation, disposal or safe storage in the environment [12, p. 11];

integration and coordination of environmental, social and economic aspects within the regional logistics

system for the purpose of environmental-oriented logistics management of the development of the region [13, p.88];

from the standpoint of ensuring the movement of material at any production processes before its transformation into a commodity and waste, followed by the latter before disposal or safe storage in the environment [32, p. 242].

Now therefore the scientific approaches to the definition of the terms «green logistics» and «environmental logistics» are systematized by classification criteria (Fig. 1).



**Fig. 1. Systematization of various scientific approaches to the definition of the terms «green logistics» and «environmental logistics» (compiled by authors)**

Analysis of scientific sources shows that there is no single approach to the definition of the concept of «reverse logistics». Most researchers argue that reverse logistics is appropriate to identify with green logistics or recycling logistics in its broadest sense.

It has been established that scientists use different terms to define the essence and content of reverse logistics, including the following:

cost, time and information optimization of waste flow streams and used products of the enterprise with all related packaging materials from the source of their origin to the place of processing or safe storage, as well as after processing to the place of their recycling [19, p. 41];

an effective tool of the mechanism of regulation of technogenic losses of industrial enterprises, which allows reducing or eliminating the destructive impact of economic activity on the environment [19, p. 42];

modern concept of waste management of enterprises as resource flows, taking into account the economic and social aspects of the effectiveness of this management [21, p. 38];

system of management of the waste flow stream arising in the course of production, distribution or packing of finished goods to increase the efficiency of the environmental protection and optimization of the costs connected with it [21, p. 38];

process of return of inventory items (withdrawn goods, packing and waste which are subject to processing and recycling) from the consumer to the manufacturer [21, p. 38];

independent scientific line, which has a certain similarity with traditional logistics, but at the same time has a certain influence on it [33, p. 187];

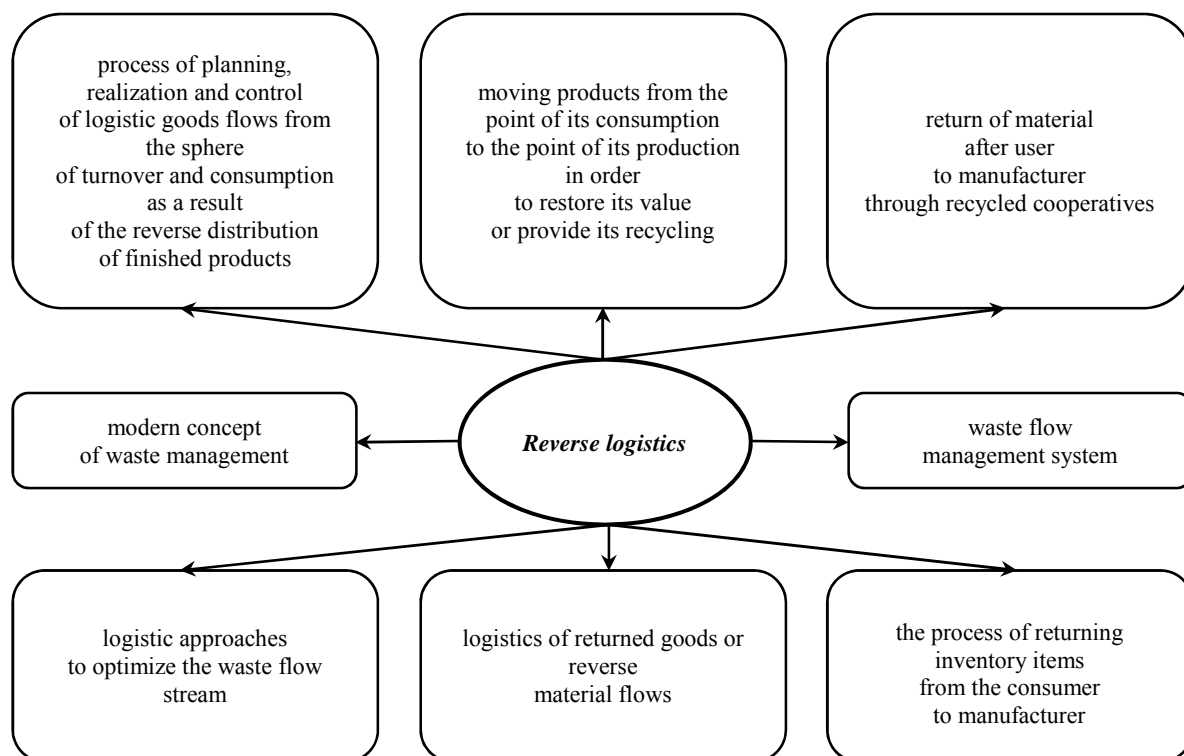
stage of development of logistics, the essence of which is the further integration of processes within the logistics chain, which occurs as a result of the integration of logistics processes in order to optimize the activities of enterprises [33, p. 187];

waste distribution, creation of the appropriate material, financial and information flows, which move in the opposite direction compared to conventional one,

processing (back in the production chain), waste incineration and energy recovery, landfill of waste [20, p. 105; 34].

Scientists note that the goal of recycling logistics is to reduce the logistics and total costs associated with waste management, and improve the level of service to the participants of the logistics chain (economic component); create conditions for safe production, improve the environmental situation in the country (social component); protect the environment from pollution by waste (environmental component) [35].

Therefore the scientific approaches to the definition of «reverse logistics» can be systematized according to 8 classification criteria (Fig. 2).



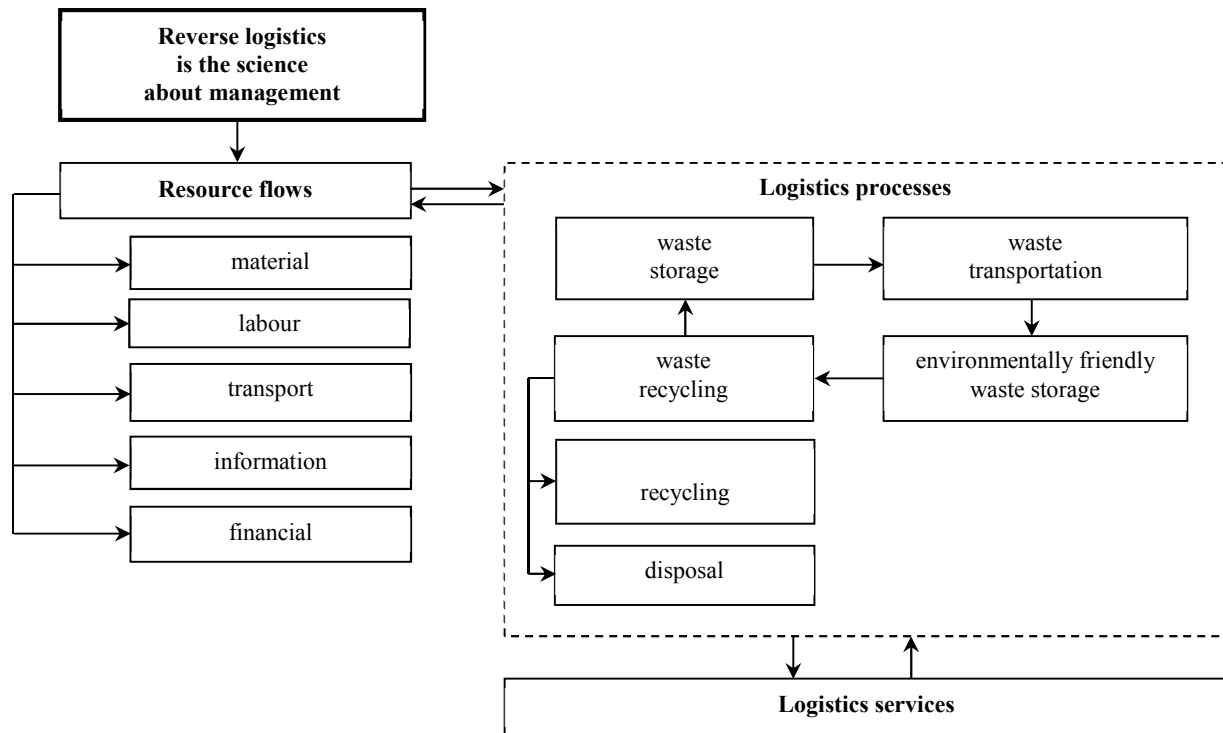
**Fig. 2. Systematization of scientific approaches to the definition of «reverse logistics»** (compiled by authors)

Based on the foregoing it can be concluded that it is advisable to apply the concept of «reverse logistics» in the field of waste management. On the basis of the analysis of definitions from the chosen subject in accordance with various scientific concepts, the content of this definition has been specified as the science of resource flow management (material, labor, transport, information, financial, etc.) in the implementation of a set of interrelated, consistently performed logistics processes (warehousing, transportation, environmentally safe storage, waste recycling) and a variety of logistics services in order to reduce logistics costs and losses by optimizing the flow and improving the information sup-

port of the movement; the increase in the quality of customer service and profitability of the sale of recycled products (Fig. 3).

The author's interpretation is quite complex and reflects the continuous process of management of resource flows in the consistent implementation of the entire list of logistics processes in waste recycling.

**Conclusions.** Therefore, reverse logistics is proposed to be considered as a type of economic activity, which includes the processes of storage, transportation, environmentally safe storage, recycling (recycling and disposal) of waste, which can reduce the negative impact on ecosystems and the environment.



**Fig. 3. Relationship of elements of the concept of «reverse logistics»**  
(compiled by authors)

The key tasks of reverse logistics include: the development of criteria for waste sorting; the use of specialized vehicles on waste transportation; cost minimization of the industrial waste management as a result of cost optimization of waste transportation from their collection sites to disposal sites; the secondary use of waste as a resource; the search for innovative waste management technologies; reduction of the negative impact of all waste management processes on regional ecosystems and the environment; the spatial and temporal transformation of waste processing.

Recycling, logistics (including environmental) outsourcing, environmental audit of the product life cycle, logistics system reengineering, personnel training, public-private partnership, venture financing are among the tools for implementing the concept of reverse logistics.

It is advisable to create an appropriate logistics infrastructure for effective implementation of reverse logistics mechanisms, namely, regional logistics centers for waste management, which should ensure coordination and partnership between all participants in the logistics chain (suppliers, manufacturers, waste collection enterprises, consumers) in a single process of creating consumer value on ecological and economic principles.

Formation and development of the concept of reverse logistics will contribute to the satisfaction of environmental requirements in the process of industrial production; selection of environmentally oriented forms of delivery; determination of optimal forms of cooperation and partnership of enterprises in the implementation of

environmentally oriented logistics processes of waste management; substantiation, taking into account the environmental factor of effective logistics infrastructure, ways and technologies of energy and resource saving in the logistics system, areas of waste recycling and methods of their environmentally friendly disposal.

The implementation of reverse logistics tools will minimize the cost of the process of waste flow while maintaining the necessary level of environmental safety, which is one of the important requirements for the implementation of integrated waste management systems under modern conditions of the development of the circular economy.

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**Залознова Ю., Квілінський О., Трушкіна Н. Реверсивна логістика в системі циркулярної економіки: теоретичний аспект**

Досліджено еволюційний розвиток і етапи становлення концепції «зеленої» логістики. На основі аналізу й узагальнення існуючих наукових підходів до визначення терміна «зелена логістика» їх систематизовано за 7 класифікаційними групами: як науковий напрям; господарська діяльність; чинник збереження довкілля за допомогою екологічно чистих технологій; інструмент забезпечення екологічної безпеки цілісної системи; сукупність логістичних підходів до оптимізації потоків відходів і ресурсів; транспортна система розподілу; спроба розробки екологічно сумісного продукту. Встановлено, що більшість науковців ототожнюють поняття «зелена» та «екологічна логістика», під якою розуміється науковий напрям, що передбачає використання сучасних інноваційних логістичних технологій; сукупність дій, спрямованих на мінімізацію екологічних наслідків логістичної діяльності; інтегроване управління логістичними процесами (виробництво, складування, транспортування відходів); підсистема управління потоками продукції від постачальника до споживача з мінімальним впливом на довкілля. Наукові підходи до визначення поняття «реверсивна логістика» класифіковані за 8 групами: сучасна концепція управління відходами; система управління рухом відходів; логістичні підходи до оптимізації руху відходів; логістика повернутих товарів або зворотних матеріальних потоків; процес повернення товарно-матеріальних цінностей від споживача до виробника; процес планування, реалізації й контролю логістичних товаропотоків зі сфери обігу й споживання в результаті зворотного розподілу готової продукції; переміщення продукції з точки її споживання в точку її виробництва з метою відновлення її цінності або забезпечення її утилізації; повернення матеріалу після споживача до виробника через рециркулярні кооперативи. Надано авторське формулювання поняття «реверсивна логістика» як виду господарської діяльності, яка включає процеси складування, транспортування, екологічно безпечного зберігання, рециклінгу (вторинної переробки й утилізації) відходів, що дозволяє зменшити негативний вплив на екосистеми та довкілля. Реалізація інструментів реверсивної логістики сприяє мінімізації витрат на процес проходження потоків відходів з одночасною підтримкою необхідного рівня екологічної безпеки, що є однією із важливих вимог до впровадження інтегрованих систем управління відходами в сучасних умовах розвитку циркулярної економіки.

*Ключові слова:* циркулярна економіка, сталий розвиток, зелена логістика, екологічна логістика, реверсивна логістика, управління відходами.

**Залознова Ю., Квілінський А., Трушкіна Н. Реверсивная логистика в системе циркулярной экономики: теоретический аспект**

Исследованы эволюционное развитие и этапы становления концепции «зеленой» логистики. На основе анализа и обобщения существующих научных подходов к определению термина «зеленая логистика» их систематизировано по 7 классификационным группам: как научное направление; хозяйственная деятельность; фактор сохранения окружающей среды с помощью экологически чистых технологий; инструмент обеспечения экологической безопасности целостной системы; совокупность логистических подходов к оптимизации потоков отходов и ресурсов; транспортная система распределения; попытка разработки экологически совместимого продукта. Установлено, что большинство исследователей отождествляют понятия «зеленая» и «экологическая логистика», под которой понимается научное направление, предусматривающее использование современных инновационных логистических технологий; совокупность действий, направленных на минимизацию экологических последствий логистической деятельности; интегрированное управление логистическими процессами (производство, складирование, транспортировка отходов); подсистема управления потоками продукции от поставщика к потребителю с минимальным влиянием на окружающую природную среду. Научные подходы к определению понятия «реверсивная логистика» классифицированы по 8 группам: современная концепция управления отходами; система управления движением отходов; логистические подходы к оптимизации движения отходов; логистика возвращенных товаров или обратных материальных потоков; процесс возврата товарно-материальных ценностей от потребителя к производителю; процесс планирования, реализации и контроля логистических товаропотоков из сферы обращения и потребления в результате обратного распределения готовой продукции; перемещение продукции с точки ее потребления в точку ее производства с целью возврата ценности или обеспечения ее утилизации; возвращение материала после потребителя к производителю через рециркулирующие кооперативы. Дано авторское формулирование понятия «реверсивная логистика» как вида хозяйственной деятельности, которая включает процессы складирования, транспортировки, экологически безопасного хранения, рецикллинга (вторичной переработки и утилизации) отходов, что позволяет уменьшить негативное влияние на экосистемы и окружающую природную среду. Реализация инструментов реверсивной логистики способствует минимизации затрат на процесс прохождения потоков отходов с одновременной поддержкой необходимого уровня экологической безопасности, что является одним из важнейших требований к внедрению интегрированных систем



управления отходами в современных условиях развития циркулярной экономики.

*Ключевые слова:* циркулярная экономика, устойчивое развитие, зеленая логистика, экологическая логистика, реверсивная логистика, управление отходами.

**Zaloznova Yu., Kwilinski A., Trushkina N. Reverse logistics in a system of the circular economy: theoretical aspect**

The evolutionary development and stages of formation of the concept of «green» logistics have been studied. Based on the analysis and generalization of the existing scientific approaches to the definition of the term «green logistics» they are systematized into 7 classification groups: such as scientific line; economic activity; factor of preservation of the environment through environmentally friendly technology; environmental safety tool in the context of the integrated system; set of logistic approaches to optimization of waste flows and resources; transport distribution system; attempt to develop an environmentally compatible product. It is established that the majority of scientists identify the concept of «green» and «environmental logistics», which means a set of actions aimed at minimization of the environmental impact of logistics activities; integrated management of logistics processes (production, storage, transportation of waste); subsystem of control of flow of products with a minimum level of eco-destructive impact of economic activity on the environment; from the point of view of a systematic approach as a scientific line, which involves the use of modern innovative logistics technologies.

Scientific approaches to the definition of «reverse logistics» are classified into 8 groups: modern concept of waste management; waste flow management system; process of planning, realization and control of logistic goods flows from the sphere of turnover and consumption as a result of the reverse distribution of finished products; moving products from the point of its consumption to the point of its production in order to restore its value or provide its recycling; return of material after user to manufacturer through recycled cooperatives; logistic approaches to optimize the waste flow stream; logistics of returned goods or reverse material flows; the process of returning inventory items from the consumer to manufacturer.

Proprietary formulation of the concept of «reverse logistics» as a type of economic activity is given the processes of storage, transportation, environmentally safe storage, recycling (recycling and disposal) of waste, which can reduce the negative impact on ecosystems and the environment.

The implementation of reverse logistics tools will minimize the cost of the process of waste flow while maintaining the necessary level of environmental safety, which is one of the important requirements for the implementation of integrated waste management systems under modern conditions of the development of the circular economy.

*Keywords:* circular economy, sustainable development, green logistics, environmental logistics, reverse logistics, waste management.

Received by the editors: 12.11.2018  
and final form 14.12.2018