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Logistic paradigm for industrial solid waste treatment processes

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Abstract

Due to the fact that industrial waste are a growing problem, both economic and environmental as their number is increasing every year, it is important to take measures to correctly dealing with industrial waste. This article presents the descriptive model of logistics processes concerning the management of industrial waste. In this model the flow of waste begins in the place of production and ends at their disposal. The article presents the concept of logistics model in graphical form together with an analysis of individual processes and their linkages, and opportunities to improve flow of industrial waste streams. Furthermore, the model allows for justification of the relevance of use logistics and its processes for waste management.

Keywords: logistics, logistics processes, descriptive model, industrial waste

1 Introduction

Logistics management of waste streams is primarily used as a tool for management in an appropriate manner all kinds of waste. Waste, and the consequences associated with their presence in the environment in recent years become a major problem in the environmental field. Hence, interest in the subject comes to waste management increasingly wider scale. Significant progress is observed in advanced technologies that not only enable the minimization of pollutants generated, but also allow for redevelopment or disposal of waste.

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The Waste Act defines it as: all items, and solids and liquids other than water management resulting from business activities or human existence and unsuitable in a place or time, which they arise; as waste is also considered sludge. In addition, has been clarified that it referred to municipal waste, which are solid and liquid wastes generated by households, in public buildings and public services, including rubbish collected in cesspools, abandoned motor vehicle wrecks and street waste, and industrial waste as any waste arising from the business (Toktay, Wein & Zenios, 2000). Municipal waste is an integral part of society, but industrial waste require special attention in the field of waste management, because they have far more negative impact on the environment.

So ecological purpose stresses the relationship between logistics and the environment, which is to protect natural resources and reducing pollution arising from the presence of waste and the economic objective is clear from the essence of logistics and to reduce logistics costs while improving service levels of logistics management of waste streams.

Logistics management of waste streams is primarily used as a tool for management in an appropriate manner all kinds of waste. Processes related to waste management permanently etched into the scope of logistics, together with still increasing amounts of waste, by-products and consumer goods have already useless after a period of use. Their integration in the logistics management of waste streams is seen as a source of significant improvement of this issue. At the same time a continuous reduction of resource materials and materials in the world requires increasingly attach importance to issues related to the acquisition of recycling, recovery and processing of used articles (Daniel, Tsoulfas, Pappis & Rachaniotis, 2004; Dima et al.). Logistic management of waste streams is the creation of logistic chains merging of waste disposal sites. It comprises the following steps: sorting of waste and their transport and storage, waste treatment, provision of secondary raw materials.

2 Waste and their logistics models in supply chains

Traditional supply chains relate to flows that begin at a point to acquire raw materials for production and ending at the point of manufacture of the finished product (Koo, Shin & Yoo, 1991; Vlăduțescu, 2014). Such a supply chain will focus on manufacturing processes while ignoring the issues of waste that result from these processes. However, due to the increasing demands of customers who are increasingly demanding a greater diversity of product range and shortening product life cycles are more often can be observed the increasing

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flow of valuable feedback, but useless in a given period (season) or morally older. In addition, the amount of waste groups and problems with their increasingly destructive impact on the environment noted theorists and practitioners of business on the waste chain, placed in the context of the concept of sustainable development. In this context, it is also speak of sustainable logistics chains, i.e. chains spring up on the basis of the concept of logistics ecological imperative. This concept comes to the treatment of logistics chains as *systems of several or a dozen other incorporated supply chains and marketing processing matter and / or energy, thus enabling the needs of individual cells in the logistics chain (the chain as a whole), which is linked to also need to remove the effects of the implementation of these needs (*Nowicka-Skowron & Man, 2010).

The waste chain is a supply chain with opposite direction of material flow to the basic supply chain. Constructing chains of waste consists different areas of the economy and is made by different rules, with the result that we find in practice variations of the waste chains.

In the municipal waste management the supply chain consists of four elements. The first is a resident who uses the product changes (decreases) its useful properties up to the moment at which the product becomes unusable. The second is the entity organizing the collection of waste from residents. It may also provide them with suitable containers, collect waste and transport it to the next chain. The third link is the person who deals with the segregation of waste, and so receives them and uses for own purposes. However, the last link is a landfill. The essence of this string is a sequence of events occurring in a particular order.

In the case of industrial waste, there is a number of possibilities to configure the chains of waste, so we can distinguish the following models here: primary one (including traditional supply chain and reverse logistics independent), closed production cycles for high-tech products (which contain dependent basic supply chain integrated with reverse logistics); closed production cycles of standard products (processed below, containing the basic independent supply chain integrated with reverse logistics), and customer oriented closed production cycles.

In Poland, the most common is the traditional model in which we deal with the flows of already unsuitable materials and products (e.g., phrases, or regarded as waste and their disposal in any predetermined way) from the existing users to a designated place (e.g., landfills or containers). This place is the beginning of the creation of a reverse supply chain functioning independently of the basic chain, which is a "supplier" of materials and products already useless (or

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waste). In this model, waste management is organized and operated by independent operator (operators) that have appropriate infrastructure and technology.

The presented models can fully describe the market situations. All can be applied in Poland, depending on the nature of the market and products. Some of them (first model) will have universal application and should be interesting to government authorities and off-road. In this regard, it is to decide who and what is carrying out the logistics management of waste streams.

The problem with this type of models is the need to cooperate with the relatively large amounts of waste producers, because they include households pooled and producers in the areas of municipalities. The quantity and volume of waste is growing so rapidly that possibilities for their lanfilling are more and more limited. Waste segregation and recovery of recyclable materials are carried on a very small scale. Lack of system solutions and low level of ecological education of society mean that the problem of waste is still increasing, posing a risk to the environment in the municipalities.

Other described models (from second to fourth) may be fundamental to creating a more effective and efficient operations, combining the knowledge and skills of the logistical issues in sustainable economy and ecology.

The second model is ideal for building chains turning professional in the field of electronic systems, warranties and post-high-tech, like the chain of efficient management of used mobile phones and waste voids peripheral hardware such as printers.

The third model can be applied to organizations of manufacturer or distributor of chain-back used for example for a smooth withdrawal of the distribution network, networks operating in the exclusive product (after-warranty and warranty) in cases where support is one of the key competitive advantage.

The fourth model, in principle, the organization of the market of spare parts and warranty support, where the role of guarantor of retailers, and they take over - provided with a power of attorney-producers decide how to consider the complaint. It should be noted that all the presented models can operate simultaneously on a given market, and this part of the market may be only a fragment of another, larger market.

Thus, experiences with the organization and functioning of traditional supply chains are fully applicable to the opposite chains - which were the essence of logistics management of waste streams.

Since the processing industry, waste management and in particular the

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logistics management of waste streams in Poland is not yet popular, there are few companies that use these concepts in their activities. Meanwhile, in a world increasingly common trend is the "Design for environment", which means the creation of such products, which are generated in the form of environmentally friendly both in terms of used the material, as well as the procedure of usage and after use.

An important aspect here is the recovery of the value held by the original product through processing, which is complex and difficult process. Even more complicated is the supply chain management which has already processed products, and market capacity against these products, which currently poses many problems because of the lack of such information.

3 Descriptive model of industrial waste management processes

Waste management is a fundamental task of logistical management of waste streams. Its processes mainly concern the appropriate organizations how to deal with waste (Beullens, 2004; Bloemhof-Ruwaard, Fleischmann , & van Nunen, 1998; Jahre, 1995; Ślusarczyk, 2007). Waste management can be viewed in terms of process and the object. Objects of control in the process term are (Kroon & Vrijens, 1995):

Prevention of waste, including became obvious by the rationalization of production and consumption;

Generation of waste, including the design of products taking into account the rest mass of recycled after use;

Separate collection, mainly by the segregation of waste at source;

Recovery of value and energy contained in waste (Skowrońska, 2007), or waste recycling in whole or in part, or recovery from waste substances, materials or energy and their application;

Recycling of substances or materials from waste in the production process in order to obtain the substances or original material or other purposes;

Disposal of waste consisting of being subjected to processes of biological, physical or chemical treatment to bring about a state that does not pose a risk to human life, health or the environment.

In terms of the preferred process is to prevent waste, became obvious in the rationalization of production and consumption, and became obvious the least desirable waste disposal. But on the other hand there is still so much industrial waste need to be proper disposed that this last activity is the most important one

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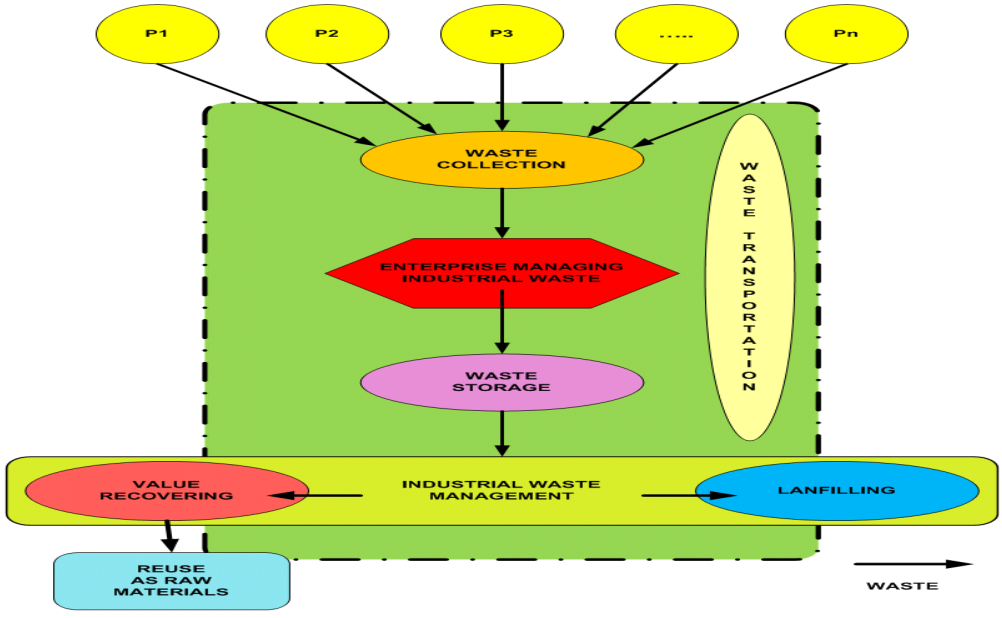
in strategic management of enterprises. What is more, most of production enterprises do not have own possibilities (i.e. techniques and technologies, resources) for waste management according to the law orders. If they will not organize that kind of activity, it might cost them very expensive in the form of high monetary punishments for causing negative effects in natural environment. This states a big incentive for companies to look for alternative solutions at this field. Such searching are resulting in higher demand on specialized industrial waste managing services, and the market`s answer on this demand are enterprises managing industrial waste.

These entities are operating on the second market and their main goal is to take care of industrial waste produced by their customers. For better illustration on the figure 1 is presented descriptive model Carter & Ellram, 1998; Gołembska, 2007; Hu, Sheu & Huang, 2002; Kleineidam, Lambert, Blansjaar, Kok & Van Heijningen, 2000; Kot, 2008; Smarandache & Vlăduțescu, 2014) of processes realized by enterprises managing industrial waste.



P1, P2, P3...Pn – customers (enterprises generating industrial waste)

Figure 1. Processes of proper waste disposal realized by enterprise managing industrial waste. (Source: Authors own elaboration.*)*

On this basis it is possible to build a general descriptive model of the performance of businesses using the concept of logistics management of waste streams (fig. 1). It should be noted that, since the logistics management of waste

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streams is not a widespread concept that requires specific knowledge of waste management, and is relatively expensive, in practice it is usually implemented partially and in a few companies, and most are not implemented at all. Therefore, companies that produce waste, outsource managing them to specialized bodies. These bodies are enterprises managing industrial waste. The model is the effect of research which objects were processes of logistics management of waste streams in enterprises managing industrial waste in Poland.

Waste management in enterprises managing industrial waste is based on a logistics management of waste streams system and is composed of four main processes: collection, storage, waste management and waste transport.

The process of industrial waste collection involves waste collection, segregation, and the development of relevant documentation relating to them. It consists of residue unification movements designed to improve their purity, together with a simultaneous reduction of their quantity. Hence the importance of proper organization this process. In addition, no less important are the regulations on proper identification and documenting the flow of collected industrial waste.

Storage of industrial waste is focused on providing sufficient space for waste and the appropriate treatment of them in due time to the most efficient possible reuse or disposal. Warehouses in the logistics processes of industrial waste streams management are used to concentrate waste from various sources, dividing them according to their use decisions, facilitate the formation of transport chains, as well as provide security for the disposal of waste, taking into account the requirements of the law (Voinea, 2011; Vlăduțescu, 2013).

Waste management is the process having a close connection with the types of waste held. The decision about their managing is not dependent on the holder of the waste, because all the issues involved are governed by the law. At the discretion of the waste holder in this regard is only to decide the ultimate point to which the waste would be send, or decide what plant provide equipment suitable for recycling industrial waste, and waste of special type transfer to landfill for disposal. In addition, the industrial waste holder is obliged to provide managing for recovery or disposal of hazardous waste must first be subjected to processes that remove their hazardous properties, as well as pre-treatment processes to effectively reduce weight and density of waste above all those that provide storage, which aims to minimize negative impacts on the environment.

Specificity of transport processes in the logistics management of waste streams system is the heterogeneity of transport facilities, high risk of

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environmental pollution in case of failure and eliminating empty carriage. These features cause a high degree of transport services complexity for industrial waste, which has a significant impact on transport costs. In addition, the transport of waste requires appropriate marking of vehicles, training drivers in the safe transport of waste and methods of action in the event of an accident. In the carriage of industrial waste are required also relevant evidence documents (Bunăiașu, 2014; Okwiet, Țenescu & Nicolescu, 2014).

By usage of presented descriptive model it is possible to systematization of information relating to industrial waste management in accordance with the processes of logistics management of waste streams and more accurate picture of the activities associated with industrial waste management in enterprises managing them, what allows for setting more precise strategy goals in strategic management. Also, consistent execution of these processes favors to received by the companies stable and competitive market positions in their area of activity. Moreover, activity of enterprises managing industrial waste should be focused on the most effective their reuse in terms of environmental protection while striving to minimize costs associated with this (Nicolescu, 2014; Bosun, Tenescu & Dima, 2014).

4 Final remarks

It should be noted that the formation processes of logistics management of waste streams is carried out through the course of its various activities, depending on the expected value of the recovery of a specific product. Admission application of the principles of logistics management in waste management is the existence of adequate logistics system. The system approach is key to understanding the principles of logistics and can be viewed spatially, organizationally and IT.

Logistically integrated waste management system can be identified and constructed in terms of functional areas. Functional areas stands out due to the activity which is related to real sphere, i.e. the formation of waste being transported to waste facilities, storage, use and destruction of economic and regulatory realm, that is, activities related to regulating and controlling the system.

The main components of logistically integrated waste management system may include subsystems: waste collection, export of waste, and commercial use, processing or disposal of waste, according to a presentation hierarchy of values in the recovery of waste, including reuse, re-manufacturing, recycling and landfilling.

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The main determinants of the functioning of an integrated logistics system of waste management are: the number, nature and spatial distribution of waste; degree, regularity and dynamics of the generation of waste, adopted rules for the implementation of environmental protection, urban spatial factors: the structure and shape the region's settlement network, the possibility of the location of system objects, routes communication, the spatial structure of economic activity, etc., overall standards and local (regional and local) requirements for allowable loads of the environment (Vlăduțescu, Negrea & Voinea, 2014; Bunăiașu, Vlăduțescu & Strungă, 2014).

Expression of the structure of the system to adapt to the implementation of tasks falling to its efficiency, reliability, availability to users, the operating bandwidth (the frequency corresponding export and processing of waste from the area), vulnerability to changes in the system, the degree of compliance with regulatory requirements and the impact of system objects on the environment.

Logistics in the field of waste management primarily emphasizes the ecological aspects. It is however foreseen that the development of logistics systems in the area of treatment will stimulate factors of marketing. Observed among customers because more and more inclined to buy a product, which is dominated by elements coming from the recovery and suitable for reprocessing. It can therefore be concluded that the logistics management of waste streams will be more widely and readily used by various operators. This will be the result of an increase public awareness of environmental issues and were forcing from the competitive market, which should be an ever larger scale appear in products and other goods produced with a focus on re-use or recover the value resulting from the use of waste future.

5 Conclusion

Summarize, it is necessary to notice how important in present time proper waste management and its processes are. Such effective tool as logistics management of waste streams gives a big support for companies and entities producing waste. It has a very positive impact on environment because that kind of activity allow for its protection. Even if the processes of waste management and logistics management of waste streams are still quite complicated, it is very important to spread such good solutions in literature, and also imply into practice.

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