5th International Scientific Conference BUSINESS AND MANAGEMENT' 2008

16–17 May 2008, Vilnius, Lithuania

Faculty of Business Management, Vilnius Gediminas Technical University
Saulėtekio al. 11, LT-10223 Vilnius, Lithuania, tel. +370 5 274 48 85; fax: +370 5 274 48 92
E-mail: busmanage@vv.vgtu.lt

THE ECONOMIC MEASUREMENT OF HAZARDOUS WASTE'S PARAMETERS IN WASTE MANAGEMENT

Anatoly Magidenko[1], Nora Dubro[2]

Department of Social Economics and Management, Riga's Technical University, Kalku 1, LV-1658 Riga, Latvia, e-mail: [1]iet@adm.rtu.lv; [2]nora.dubro@vidm.gov.lv

Abstract. Establishment of a hazardous waste management system is one of the most important stages in the development of the total waste managenent system in Latvia as one of the priorities of environment protection at present. Ecological position in the state being indicatively reflected on the quality of natural resources and labour force influences well-being directly. Hazardous waste present particular threats to human health and ecosystems immediately or over an extended period of time. Introduction of new technologies and equipment, transition to the use of less hazardous or cleaner raw materials, establishment of a system of incentives for the minimisation of waste generation are the best applicable instruments in hazardous waste management. The most important stage in the estabilishment of hazardous waste managenent system is working out the economical approaches for measurement of hazardous waste's parameters insuring adequate planning of financing. The purpose of the paper is to propose an algorithm for calculation of total predictable costs of hazardous waste management system.

Keywords: hazardous waste, flow and composition**,** economical impact, the unit of base danger, financing of management system.

1. Introduction

The Republic of Latvia, on joining the European Union, has taken responsibility to improve the environment in general and situation in the waste management field in particular. Creation of a hazardous waste management system is required according to the "Law on Waste Management", and as a target stated in the "Multi Year Waste Management Plan for Latvia, years 2003–2012" approved by the Cabinet of Ministers on August 21, 2002. This is also directly linked to EC directives, which require Latvia and other European members to prepare specific implementation plans [1].

According to Waste Management Law a *hazardous waste* is a waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and other life forms when mismanaged or released into the environment [2].

Research of normative acts covering hazardous waste management system in Latvian Republic [3], the object of what is the economical measurement of hazardous waste's parameters, shown that legislation has not been worked out and approved still. Formulation of methodic approach for adequate planning of investment in hazardous waste management system was the goal of the stage of the research the results of which are creation of demonstrative models and new parameters of hazardous waste's economical impact measurement. Methods of systematic analysis, logics and synthesis were used in this research.

2. The main economical aspects of development of hazardous waste management system in Latvia

Until 1995 in Latvia there was no unified state policy and hazardous waste management varied significantly through out the country. Then Latvian state investment program was reconsidered in result of what in hazardous waste management system was comprised new necessary elements, legislation was started to introduce to meet the requirements of the EU directives, a range of other companies gradually became involved in hazardous waste management, the activities of which were initiated by market forces. During the last 12 years, Latvia has made significant improvements in the sphere of hazardous waste management. Only during the last few years measures, regulating the management of the hazardous waste so as not to violate the interests, namely, life and health of a persons as well as the property of the person have been undertaken to observe the international liabilities and take into consideration the EU experience. The produced amount of hazardous waste has decreased by 2.7 times, in comparison to that in 1990 [4, 5].

40 enterprises involved in collection and processing of hazardous waste were registered in Latvia in

2000. At these enterprises, of the received waste amounts, 3 % were incinerated and 69 % were physically-chemically reprocessed [5].

Latvia became an EU member in May 2004. In general, transposition of the acquis regarding hazardous waste management has been completed, but implementation of legislation is ongoing concerning optimization of the enforcement system. Implementation of legislative acts is ensured in investment projects regarding the establishment of hazardous waste management infrastructure and institutions managing investment projects and infrastructure.

The principles of the EU's waste management policies and strategy are implemented primarily by EC directives, regulations and decisions that create binding legal obligations on Member States [6]. Not looking at successful tendencies in transformation of system of hazardous waste management there is no one common system of hazardous waste management with services accessible to any resident or enterprise in Latvia till now. There is still much to be done and the following problems exist:

1) no general legislation for solid waste management;
2) a lack of local regulations;
3) not all waste producers pay for waste collection/management;
4) the distribution of responsibilities, duties and rights among municipalities and waste management organizations is still unclear;
5) the largest portion of waste management is undertaken by private companies whose financial resources are insufficient and whose technical equipment does not always meet the required level;
6) most cities and municipalities do not have the means to improve their waste management system yet they still are responsible for waste collection in their regions. As a result, violations occur [7].

Uncontrolled waste dumping in the territory of Latvia is a serious concern. It pollutes forests, degrades landscapes and creates hundreds of illegal local waste dumps containing wastes of unknown composition and origin. Old landfills that are closed continue to pollute groundwater. This process may continue for many years unless necessary measures are undertaken to rectify the situation [8].

So, the possibilities for waste processing are limited. Legislation demands that qualitative and quantitative analysis of waste is required, although this is not always done. The great amount of hazardous waste is not managed in a socially and and ecologicaly friendly way still. The amounts of hazardous waste are reported by enterprises to the Latvian Environment Agency. However, sometimes enterprises do not conduct analyses to determine the presence of hazardous wastes, but nevertheless include the waste in the hazardous category [4].

3. The flow and composition of Hazardous Waste

Latvia produces approximately 60,000–70,000 tons of hazardous waste annually [4]. Problems of formation, gathering, accumulation, storage and processing of a hazardous waste in Latvia can be subdivided conditionally on two categories: management of a "historical" waste and management "flowing" and "future" streams of the household hazardous waste which relative density makes 20 %, and a waste of industrial technological processes. The annual average amount of collected hazardous waste is estimated by 4 kg per inhabitant (including the amount of fazardous waste that will be collected from small businesses). The assumption follows from the fact that hazardous awste constitutes up to 2 % of the total waste weight [3, 9].

The amount of produced hazardous waste was around 180,000 tonnes, including 88,000 tonnes of sludge and other waste from the waste water treatment processes and 49,300 tonnes of liquid waste from metal working and metal plating in 1997. Approximately 41,000 tonnes of hazardous waste contains oil products. About 1,200 tonnes are part of mixed municipal solid waste and inclusion of this amount into the category of hazardous waste is not justified mostly [10].

Formation of the majority of categories of a hazardous waste, such as a medical waste, old motor vehicles and the electrical engineer is inevitably.

With the growth of welfare in the state, grows amount of cars in Latvia that increases annual volume of the used automobile tyres, lead accumulators and the other components demanding definite processing and a safe burial place. In addition, automobile technical liquids represent considerable danger. Car middle age in Latvia makes 13 years, and 86 % of the cars imported into the country concern a category of the second-hand, therefore the question of the further destiny of the cars, which have served for Latvia, is especially actual. With the introduction into EU, Latvia should achieve 70–85 % reuse of the weight of each old car. The run of this norm demands the additional financing the main source of what are payments of the tax to natural resources on the vehicle registered in the state [9, 11, 12].

Latvia imports 25 thousand tons of the electronic and electric equipment, which is necessary to collect and process on the service expiry, annually, for what, according to 20.4 point of the Waste management law, are responsible manufacturers and sellers of the equipment that cause them an additional expenses [13].

It is necessary to add, that in Latvia it is saved up to 2,3 million tons asbesos waste, 2,2 million tons from which is asbestine cement plates, or slate and 20 thousand tons – thermal protection materials. According to the state positions an obligatory duty of the Latvian inhabitants, which own the slate containing asbestos, is disposal of the given hazardous material till 2010 in an order established by the law [9, 14].

Thus, despite to concentration of attention on ecological problems acception of about 200 acts of EU in the ecological sector, it is possible to ascertain the deep imperfection of system, which threats ecology of environment and public safety.

4. Economical impact of hazardous waste, alternative renewable energy system and the unit of base danger of waste

The majority of hazardous waste generators don't estimate the unitary economic impact of management of hazardous waste. Transportation and recycling costs of hazardous waste are significant, that's why fee for provided services will be determined in conformity with the incurred costs. The "Polluter pays" principle attempts to solve these problems at source either by introducing cleaner technological processes or other purification methods [1].

During the course of privatisation of industrial enterprises and territories, stockpiles of raw materials and by-products, pesticides, artificial fertilisers, and other chemical substances have been left without control. The storage conditions are often unacceptable and may present direct threats to human health and ecosystems [3, 9].

Waste storage sites are significant sources of localised water, air and soil pollution. The quality of life of local populations is decreased and, in many cases, drinking water is polluted. Landfills are usually very poorly planned and equipped, and are mostly overburdened. Since the dumping of waste is not properly controlled, hazardous wastes are often dumped in addition to regular household wastes [3, 9].

Liquid industrial wastes, including toxic wastes, are often discharged into domestic sewerage systems, thus damaging water treatment facilitates and highly polluting the water. Hazardous wastes present particular threats to human health and ecosystems what refelcts as immediate and future economical losses (Fig 1) [3, 9].

Besides, waste is a loss of useful materials that would be recycled or reused. The Earth ceases to be a source of perpetual resources. Now, when the population of the planet has exceeded 6 billion, the threat of deficit of natural resources has forced scientists of all worlds to be concentrated on the searche of alternative methods of energy saving and extracting. It is expected that prices of energy rising in the future would increase demand for energy efficient/saving technologies among industrial users [15, 16].

The high demand among municipalities for heat recovery and energy saving technologies, new/efficient energy and heat operation systems, and retrofitting/rehabilitation of the existing systems is fueled by poor efficiency and large energy losses in the existing heat supply systems, creating pricing problems for consumers [15, 16].

Alternative/renewable energy exctracting technologies was not ranked as important by the industry sector till the starting of manufacture and production of the synthetic materials when the problem of waste management has ripened [15, 16].

Researches of causes and effects lead scientists to identification of optimum strategy for struggle with natural dis-balance – the synchronous solution of both problems, by application of energy saiving technologies [15, 16].

It is obvious, that formation of a waste results not only in environmental contamination, but also in losses of materials and energy (Fig 2), additional economic costs and the ecological consequences connected with gathering, processing and waste disposal [15, 16].

The basic methods of energy's saving are *secondary use*, *recovery* and *energy extraction*. In case of a hazardous waste, the preservation of resources is very difficult, but is possible. Only some hazardous waste can be processed or secondary used. The basic volume is liable to destruction. Traditional processes in Latvia are more extended, but the active tendency of transition on innovative *resource saving* and *energy-extracting* methods are traced [15].

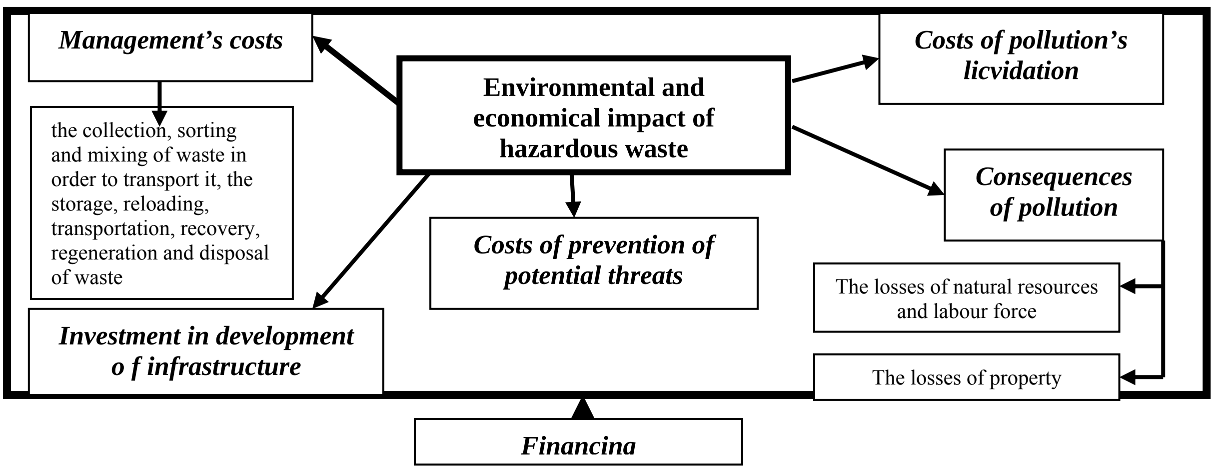

Fig 1. The model of the economical impact of hazardous waste

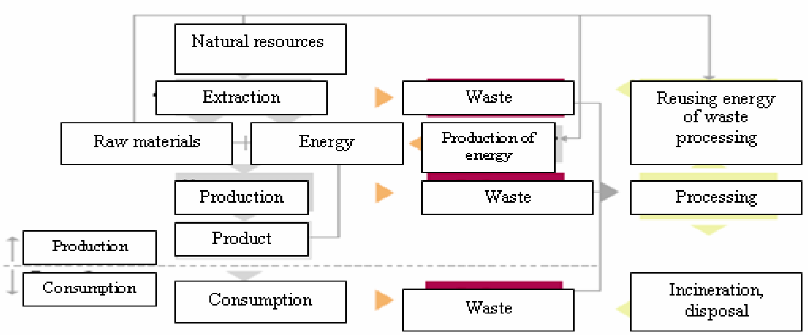

Fig 2. Energy losses in result of waste's formation [16]

It is possible to part off the glass which inert features allow lost-free recycling. So educes materials as metals (aluminum in process of secondary use consume only 5 % from energy of production from a primary material), plastic (result of the burning of 1 kg of polymer is equivalent to result of the burning of 1 kg oil) are alternative energy sources. [15, 16, 17]

However, it is necessary notise, that the aspiration to give an eternal life to resources is restricted by the objective borders designated by the loss of properties and deterioration of primary materials. So, experience shows that secondary glass in manufacture is suitable only as 24–35 percentage impurity to primary materials. The closest rospect of energy saving in process of management of a hazardous waste in Latvia is the use of energy, exctracted in result of inceniration of a hazardous waste in specialised installations. This energy can be directed on heating of near buildings, thus saving coal. Heat exctracted in result of inceniration of a hazardous waste can be used also for creation of steam actuating the generator of the electric power, but the lead exctracded from served automobile accumulators is quite suitable for release of new accumulators [15, 16, 17].

The most perspective hazardous waste is automobile tyres which application is possible as a heat (1 ton of tyres replaces 0,7 tons of combustible fuel) and in building (the Latvian company "Broceni" replaces 500 kg of black oil with 700 tons of old tyres turning it in the clinker). The various economical results with various degree of influence on environment are possible depending on a method of use of tyres.

The most ecologically justified action with the worned tyres is mechanical crushing in result of which are received the rubber powder applied in the different areas, in dependence of the size of the received granules. Small, particles (180 micron) can be used as filler in rubber manufacture. The more rough powder (0,5 – 3 mm) also has found a wide area of applications. The firm «Eko osta» has incurred the decision of a problem of processing worned old tyres, having got the equipment of the German company «Eric Schomberg» which allows to recycle 5 tons of tyres per hour into a rubber crumb which can be used in road building, manufacturing of special roofing, sports, decorative coverings, etc. Company SIA "Cemex" is engaged in manufacture of cement in the course of processing of a hazardous waste as alternative fuel applying the used lubricant oils and the worned tyres [15, 16, 18, 19].

The alternative methods of energy saving is increase of efficiency of processing by optimisation of qualitative structure of party of a waste, considering possibilities of compatibility of substances on the basis of their physical and chemical properties and technical possibilities of installation.

The processing stream should be organised being based on heat capacity of definite substances, and also considering the maintenance of halogens, sulphur and other chemical elements. At various qualitative structures of a stream of a waste, processing can be characterized with various indicators (various capasity of processing and costs). According to identical indicators of capacity there can correspond different levels of expenses.

We proceed from volume parametre, estimating necessary investment in processing system, being based on relative density in the general number of a waste ussually speaking about a measure of influence of hazardous waste on environment. It is necessary to notice, that volume is not the best indicator in case of an estimation of a hazardous waste. The most correct parameter is the *danger*.

The danger of waste – the real theath of harm to environment and damage to property. Hazardous waste includes wastes that belong to different categories of danger. On dependence of chemically-phisical properties each standard category of hazardous waste can be subdivided into several categories of danger. The most dangerous types of hazardous waste are contaminated soil, oil filters, waste from metal works, filter cleaning materials, paint sludge, wastewater sludge polluted by toxic substances, different types of engine oils, organic solvents containing halogens and sulphur, waste containing heavy metals, waste from meat and fish processing, and lamps containing mercury. So kind of waste can be selected in each standard category.

Assuming that potencial degree of losses is various in result of pollution of environment with waste of different categories it is possible to measure danger of a separate category of a waste financially. It is necessary to note that the danger of the definite category must be characterized not only with danger of a unit (for example, 1 kg), but also with annual volume of a certain category ‘s waste.

Depending on a category of danger of a waste relative density of each category of a waste will be various. Physical and chemical properties that do more especially danger this or that stage of management determines it. The definite methods of processing must be used according to category of danger and accordingly definite investment must be directed to management of waste that belong to different categories of danger (Fig 3).

So, the amount of investments depends on the base danger of a category what depends on chemically-phisical features.

$$Ci=Kd*D, \quad (1)$$

where Ci – costs of the unit of a danger of waste that belong to category i; Kd – factor describing the relative danger of category what is determined by physical and chemical properties; D – the base danger of a category

Total expenditures of the unit of a danger of hazardous waste that belong to definite category of danger in definite period of time can be described as the accumulation of costs of existing system’s management, costs of infrastructure’s development and costs of potencial polution’s prevention.

$$\text{Cit} = \text{Cm(i)t} + \text{Cinfr(i)t} + \text{Cppp(i)t}, \quad (2)$$

where Cit – total expenditures of the unit of a danger of hazardous waste in the period of time t; $Cm(i)t$ – costs of management of the unit of a danger of waste that belong to category i in the period of time t;$Cinfr(i)t$ – costs of infrastructure’s development for the unit of a danger of waste that belong to category i in the period of time t; $Cpp(i)t$ – costs of potencial polution’s prevention from the unit of a danger of waste that belong to category i in the period of time t.

Besides, costs of existing system’s management are possible to subdivide according to stages of waste management. *Management of the hazardous waste* include the collection of waste (including, the collection, sorting and mixing of waste in order to transport it), the storage, reloading, transportation, recovery (including waste incineration to obtain energy, equipment the core activity of which is not waste incineration), regeneration and disposal of waste (including, incineration in municipal waste incineration equipment), the supervision of such activities, as well as the construction of sites for disposal of waste, and maintenance and after-care of recovery facilities after their closure [2].

$$\begin{aligned}\text{Cm(i)t} = {} & \text{Cc(i)t} + \text{Cts(i)t} + \text{Ct(i)t} + \\ & + \text{Cp(i)t} + \text{Cr(i)t} + \text{Cd(i)t},\end{aligned} \quad (3)$$

where $Cc(i)t$ – costs of collection of the unit of danger of waste that belong to category i in the period of time t; $Cts(i)t$ – costs of temporary storage; of the unit of danger of waste that belong to category i in the period of time t; $Ct(i)t$ – costs of transportation of the unit of danger of waste that belong to category i in the period of time t; $Cp(i)t$ – costs of pocessing of the unit of danger of waste that belong to category i in the period of time t; $Cr(i)t$ – costs of recycling of the unit of danger of waste that belong to category i in the period of time t; $Cd(i)t$ – costs of depositon of the unit of danger of waste that belong to category i in the period of time t.

Unit of the base danger of a waste – weighted average danger of waste of all categories.

To appreciate *unit of base danger* of a waste it is necessary information about relative danger of each category, number of categories, annual volume of generation of categories.

Hazardous waste category	***Category of danger***			
	A	**B**	**...**	**i**
Explosive	A(E)	B(E)	...	i(E)
"Oxidising	A(O)	B(O)	...	i(O)
"Highly Flammable"	A(HF)	B(HF)	...	i(HF)
"Flammable	A(F)	B(F)	...	i(F)
"Irritant"	A(Ir)	B(Ir)	...	i(Ir)
"Harmful"	A(H)	B(H)	...	i(H)
"Toxic"	A(T)	B(T)	...	i(T)
"Corrosive"	A(C)	B(C)	...	i(C)
"Infectious"	A(Inf)	B(Inf)	...	i(Inf)
"Toxic for reproduction"	A(T_for_r)	B(T_for_r)	...	i(T_for_r)
"Mutagenic"	A(M)	B(M)	...	i(M)
Substances and preparations which release toxic or very toxic gases in contact with water, air or an acid.	A(S1)	B(S1)	...	i(S1)
Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.	A(S2)	B(S2)	...	i(S2)
"Ecotoxic"	A(E)	B(E)	...	i(E)

Method of processing → ***Costs of management***

Fig 3. Model of hazardous waste processing’s costs dependence on category of danger

The mosts important factor in an estimation of danger of waste is *the factor of time*. Time is irreparable. Similarly to lingering illness what progresses in human organism persistently and lead to irreversible consequences, long stored unprocessed waste damage to ecosystem, infect it and stimulate irreversible changes. The longer waste are unmanaged, the greater damage is drawn making the grosser economical losses. The estimation of influence of factor of time on waste's degree of danger demands separate evaluation. So, in the long run the unit of the base danger of unmanaged waste can increase as well as economical impact.

It is necessary to consider, that depending on category's specificity, danger of separate processes can prevail (Table 1) in result of what definite stages of waste management demands for various investments. The total costs of hazardous waste management managements are different too.

The simplified model of economical impact of hazardous waste in process of management's relation with the unit of base danger of waste (Fig 4) excludes posibbility of the dinamic of degree of danger.

As it is known, financial costs are divided into two categories*: current expenditure,* that includes the sum of used materials costs for the operation of technologies and facilities for objects of environmental protection, their maintenance, decreasing the pollution that has arisen from the operation of enterprises (emissions in air, waste water discharge, waste etc.) in environment, and investment, that includes capital investment on environmental measures, which the main goal is to collect, treat, control, decrease, prevent or eliminate pollution or any other environmental degradation caused by the production process of enterprises [1]. This two categories are accumulated in the concept „*investment on the unit of base danger of waste*" what characterizes necessary *finances for* neutralization of the unit of base danger of waste *in definite period of time*.

Table 1. Costs of hazardous waste management in dependence on category of danger evaluation matrix

Category of danger	Cc, %	Cts, %	Ct, %	Cp, %	Cr, %	Cd, %	Cinfr, %	Cppp, %
A	4	10	4	20	20	20	10	12
B	4	6	6	20	22	20	10	12
C	10	2	10	15	16	20	20	2
...	...	...	...	...	...	...	...	...
i	36	2	14	8	8	12	0	20

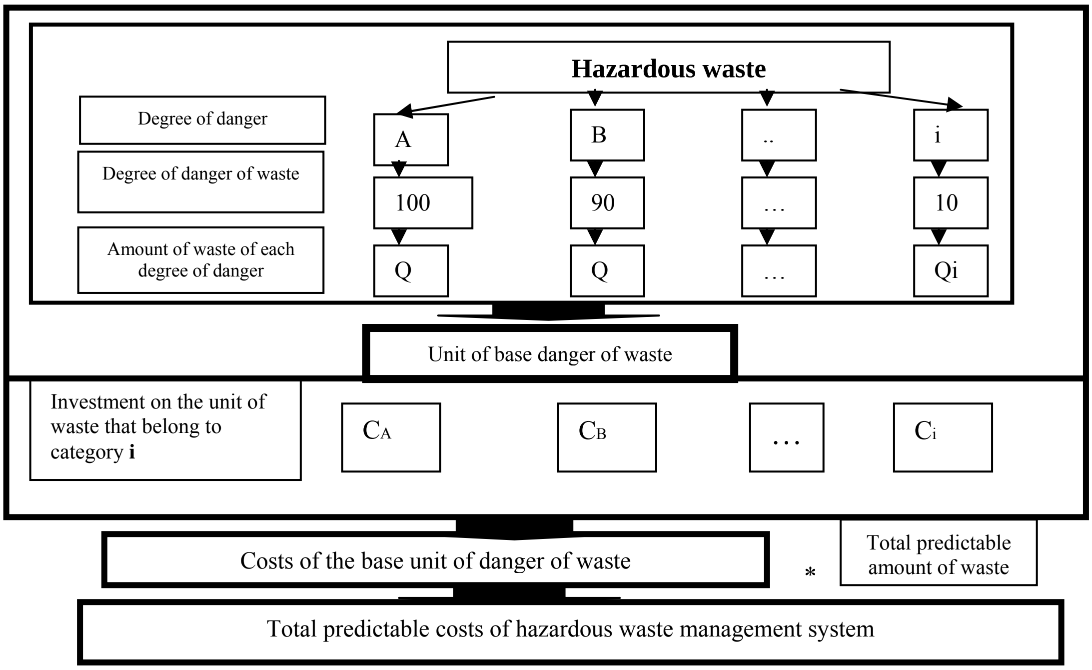

Fig 4. The relation of economical impact with the unit of base danger of hazardous waste in process of management

5. Investment on the base unit of danger of waste

The amount of capital and current costs for establishing of hazardous waste management system depends on the unit of base danger of waste *D* what is possible to determine for each category in rezult of phisicaly-chemical analysis. according to novel approach Simplified approximate economilal expression of the unit of base danger can be determined hrough amount of hazardous waste.

$$D_{ek} = \sum_{n=1}^{i} Qit * Cit, \tag{4}$$

where D_{ek} – economical value of the unit of base danger in the period of time t;
Cit – costs of the unit of danger of waste that belong to category i in the period of time t;
Qit – total amount of hazardous waste that belong to category i in the period of time t;
Qt – total amount of hazardous waste in the period of time t;
i – number of categories;
t – duration.

Costs of the base unit of danger of hazardous waste is possible to calculate correcting economical value of the unit of base danger with factor describing the rate of inflation.

$$C_{ut} = \mathrm{K}_t * \frac{\sum_{n=1}^{i} Qit * Cit}{Qt}, \tag{5}$$

where C_{ut} – costs of the base unit of danger of waste for the period of time t;
K_t – factor describing the rate of inflation in the period of time t;
Cit – costs of the unit of danger of waste that belong to category i in the period of time t;

Thus, prognosing amount of waste and inflation it is possible to plan and optimize the budget for the program of hazardous waste management. The greatest complexity is represented by division of a waste on categories of danger and definition of expenses at each stage of waste management.

5. Conclusions

As a result of economic activities, new and complex environmental problems have appeared, that cannot be characterized by any one specific environmental quality indicator. Presented models shape conception about economical impact of hazardous waste in Latvia, formulas describe the main relationships between hazardous waste's parameters and waste ecological impact, as well as provide possibilities of measurement of economical influence in waste management.

The set of formulas, which consist of the mathematical expression for evaluation of economical value of the unit of base danger in the period of time, formulas for calculation of costs of the waste danger unit, that belongs to the definite category, and for estimation of a total expenditures of the hazardous waste danger in the fixed period of time, is based on two demonstrative models:

- Model of the economical impact of hazardous waste what represents the main structural composition of expenditures of hazardous waste management.
- Model of hazardous waste processing's costs dependence on category of danger.

The algorithm for calculation of total predictable costs of hazardous waste management system, which combines two above mentioned models, is proposed as design of relation of economical impact with the unit of base danger of hazardous waste in process of management is the main theoretical result of research. The algorithm is suitable for the complex solutions of the objectives of the whole strategic planning of hazardous waste management system by racionalization of the strategic investment's flow insuring the pricize evaluation of necessery expenditures in each stage of hazardous waste management basing on category of danger. Method is devised for more efficient financing planning in development of hazardous waste management system, turning the fundamental investment to management of waste which belong to higher degree of danger and minimizing the costs of the waste processing sorting hazardous waste according to economical value of the unit of base danger and is harmonized with basic objectives of EU policy on waste management.

References

1. Feasibility Study for Hazardous Waste Management System. *Selection of Sites for Construction of Collection Stations for Hazardous Waste*. Contract No. GEME 2-ISPA-LE-SAO/ENV-HW "Development of Hazardous Waste Management System in Latvia", 2005, p. 15 – 71.
2. Waste Management Law, [Electronic resource] – Read 11 November 2007 - www.eel.nl/documents/latvia/Waste_Management_Law_Latvia.pdf.
3. The Survey about Hazardous Waste Management System in Latvia, 1998 (Pārskats par bīstamo atkritumu apsaimniekošanu Latvijā, 1998), [Electronic resource] – Read 10 October 2006 -http://www.vidm.gov.lv/lat/dokumenti/publikacijas/investiciju_joma/?doc=1690 (in Latvian).
4. The Develeopment of Hazardous Waste Management System in Latvia (Bīstamo atkritumu apsaimniekošanas sistēmas izveide Latvijā) [Electronic resource] – Read 5 July 2006 - http://www.vidm.gov.lv/files/text/ba_strat.pdf (in Latvian).
5. Inveronmental Indicators in Latvia 2002. Raised Risk Factors for the Environment. Hazardous waste. [Electronic resource] – Read 10 October 2006 -

http://enrin.grida.no/htmls/latvia/faktori/atkritumi/bist_atkr.htm.
6. Application of Assistance for Project Hazardous Waste Management System in Latvia, Stage I, 2005, p. 9.
7. Demand for Environmental Technologies [Electronic resource] – Read 11 November 2007 - http://www.rec.org/REC/Publications/ETSurvey_Baltic/FeeBased/Latvia5.html.
8. Environmental Impact of Waste. National Environmental Policy Plan for Latvia. Overview and Analysis of Priority Environmental Problems. [Electronic resource] – Read 11 November 2007 - http://www.lva.gov.lv/NEPP/54.htm.
9. Hazardous Waste (Bīstamie atkritumi), [Electronic resource] – Read 5 Juny 2007 - - http://www.zalajosta.lv/index.php?option=com_content&task=view&id=38&Itemid=47 (in Latvain).
10. Generation of Hazardous Waste. Latvian State of the Environment Report' 1997, [Electronic resource] – Read 5 Juny 2007 - http://www.lva.gov.lv/produkti/soe97_eng/texts/hazwaste/hwt_prs.htm (in Latvian).
11. Sewage, Tyres and Medical Waste (Notekūdeņi, riepas un medicīnas atkritumi), [Electronic resource] – Read 10 October - http://www.tvnet.lv/zalazeme/trash/article.php?id=7677 (in Latvian).
12. The Project of Operational System "Infrastructure and Services" (Operacionālās programmas „Infrastruktūra un pakalpojumi" projekts), [Electronic resource] – Read 5 Juny 2006 - http://www.politika.lv/index.php?f=995 (in Latvian).
13. What to do with outworn tyres? (Ko darīt ar nolietotajām elektroprecēm), [Electronic resource] – Read 10 October 2006 - http://www.delfi.lv/news/national/green/ (in Latvian).
14. The Issue of Asbestos Waste: the Government Against Inhabitants (Azbestu saturošo atkritumu lieta: valsts pret iedzīvotājiem), [Electronic resource] – Read 5 Juny 2007 - http://videsvestis.lv/content.asp?ID=81&what=22 (in Latvian).
15. Formation of Waste and its Disposal, [Electronic resource] – Read 5 Juny 2007 - http://reports.eea.europa.eu/environmental_assessment_report_2003_10/ru/ru_07_0.pdf (in Russian).
16. "People – Waste – Environment" („Cilvēks – Atkritumi – Vide"), [Electronic resource] – Read 5 Juny 2007 - http://www.zalajosta.lv/ (in Latvian).
17. Your choice: to not pollute, [Electronic resource] – Read 5 Juny 2007 - http://www.majalv.eu/main.php?lang=ru&p=5&n=246&a=3777 (in Russian).
18. The Issue of Outworn Tyres is Sold in Latvia, [Electronic resource] – Read 5 Juny 2007 - http://news.colesa.ru/news/1361.html (in Russian).
19. Tyres in the Fire?! (Riepas ugunskurā!?), Electronic resource] – Read 5 Juny 2007 - http://www.videsvestis.lv/content.asp?ID=41&what=12 (in Latvain)