



## **Analysis and Improvement Possibilities of Hazardous Waste Management System in Lithuania**

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Lithuanian hazardous waste (HZW) management system is analysed in the paper. Successful functioning of the system is based on coordination of different means: effective hazardous waste prevention, recycling, incineration. However, successful system functioning is hardly attainable without other measures, such as long – term policy, circulation of information, punishment inevitability, establishment of infrastructure, and stimulation of the system participants by economical means.. The governing principle for hazardous waste is the order of preference or waste hierarchy. In the waste hierarchy, waste prevention is preferable to recycling, recycling is preferable to incineration with energy recovery, and the landfilling is at the bottom of the “ladder”.

The possibilities of improvement are proposed considering the obtained analysis results.

Key words: *hazardous waste, waste prevention, hazardous waste management, system analysis.*

### **1. Introduction**

Hazardous waste arises from a wide range of different sources including households, commercial activities and industry. Hazardous waste represents approximately 1 % of all waste generated in Europe. Wastes are classified as being hazardous depending on whether they exhibit particular characteristics. The main disposal route of hazardous waste is incineration, physical or chemical treatment and landfill. On the recovery side, a significant proportion of hazardous waste is recycled or burned as a fuel.

Though hazardous waste represents only approximately 1 % of all waste generated in Europe, it can present a potential risk to both human health and the environment. Hazardous waste is typically the subject of special registration and requires special management arrangements to ensure that hazardous waste is kept separate from and treated differently to non – hazardous waste [2].

Each year in the European Union generates 40 million tones hazardous waste [3]. According to the National waste accounting database and Register of waste management the total amount of hazardous waste generated in 2004 in Lithuania is 118 thousand

tonnes. According to the EU legislation, until 2012 there would be closed all about 800 at a current moment operative landfills and set up 11 modern regional landfills and one for hazardous waste. After 2012 landfilling of untreated hazardous waste will be banned. Because of this reason it is important to analyse the hazardous waste management system in Lithuania and to introduce a proposal for its improvement.

### **2. Analysis of Lithuanian hazardous waste management system**

Our research was focused on the study of hazardous waste using the data based on the European Waste Catalogue according to waste classification and which was valid in Lithuania in 2004.

The methods of a system approach and comparative analysis were applied. The data were collected from the informal interviews and questionnaires survey done by interviewing Lithuanian hazardous waste management system

stakeholders. In addition, different databases were used –the data of National Waste Accounting, Waste Managers Register, and National Environmental Inspection database on Violation (2004), data from Department of Statistics (2004). The Reports of 8 Regional Environmental Departments [6, 7, 8, 9, 10, 11, 12, 13], different legislative acts and various scientific research works were analysed.

## **2.1 Definition and classification of hazardous waste**

Hazardous waste defined as liquid, solid or combination of solid waste whose concentration, due to its quantity, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness or pose a substantial hazard to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed [1].

The European Union definition of hazardous waste is directly linked with three Annexes of the EU Hazardous Waste Directive 91/689/EEC (categories of hazardous waste, constituents of hazardous waste and hazardous waste properties), as well as with the List of Waste 200/532/EC drawn up on the basis of these Annexes. For the purpose of this Directive “hazardous waste” means the wastes featuring on the list to be drawn up [...] on the basis of the Annexes I and II to this Directive. These wastes must have one or more of the features listed in the Annex III. The list shall take into account the origin and composition of waste and, where necessary, limit the values of concentration. [...] any other waste which is considered by a Member State to display any of the properties is listed in the Annex III.

A List of Wastes integrates the list of wastes drawn up according to the Article 1(a) of the Waste Framework Directive 75/442/EEC and that of hazardous wastes drawn up according to Article 1(4) of the Directive 91/689/EEC. According to the List of Wastes “any waste marked with an asterisk (\*) is considered as a hazardous waste pursuant to the Directive 91/689/EEC on hazardous waste, and subject to the provisions of that Directive unless Article 1(5) of that Directive applies” (Annex, paragraph 4). Wastes can be classified as hazardous also taking into account limit values of concentrations of dangerous substances according to Article 2 of the List of Wastes.

The definition of hazardous waste in Basel Convention is based on the same principles as the EU definition, but refers to the national legislation. The following wastes that are subject to transboundary movement shall be “hazardous wastes” for the purposes of this Convention: (a) Wastes that belong to any category contained in Annex I, unless they possess any of the characteristics contained in Annex III; and (b) Wastes that are not covered under the paragraph (a) but are defined as, or are considered to

be, hazardous wastes by the domestic legislation of the Party of export, import or transit.

The hazardous waste definition in the OECD/Eurostat Joint Questionnaire refers to the Basel Convention definition. Correspondingly, hazardous waste is classified in the Joint Questionnaire according to Y – codes of the Basel Convention. Hazardous wastes refer to the categories of waste to be controlled according to the Basel Convention on the control of transboundary movements of hazardous waste and their disposal (Article 1 and Annex I).

Definition and classification of hazardous waste in Lithuania is the same as in all the European Union. Lithuania uses two different waste classifications in parallel, the Lithuanian list on wastes (Annex II WMR) and the statistical classification of wastes (Annex XI WMR). The Lithuanian list of wastes is prepared in accordance with the European waste catalogue and the hazardous waste list whereas the statistical classification of wastes corresponds to the substance – oriented EWC – Stat as included in the draft Council regulation on the waste management statistics. Both classifications were established by the regulations on waste management in 1999 and have been valid since the beginning of the year 2000. As of 2004, these classifications were replaced by the European waste list (Commission Decision 2000/532/EC and subsequent amendments) and the EWC – Stat2 was included in the waste statistic regulation (2002/2150/EC) [15].

The analysis is carried out according to the hazardous waste classification given in the Lithuanian Waste Management Regulation (2003).

## **2.2 Hazardous waste legislation in Lithuania**

Hazardous wastes pose a greater risk to the environment and human health than non hazardous wastes and thus require a stricter control regime. This is laid down in the Directive 91/689/EEC, as amended by the Directive 94/31/EEC. The properties which render waste hazardous are laid down in the Directive 91/689/EEC and are further specified by the Waste List Decision 2000/532/EC as at least amended by the Decision 2001/573/EC. The requirements of the mentioned Directives are transferred to Lithuanian waste legislation.

The framework for Lithuanian waste legislation is defined by the Law on Waste Management (1998 with amendments). Most waste management activities regarding hazardous waste and non-hazardous industrial waste are regulated by the Waste Management Regulations (thereinafter WMR), approved in 1999 by the Minister of the Environment. The waste management regulations contain provisions on waste management plan, registration of waste managers, waste statistics, hazardous waste management and documentation of waste management activities.

**Permit and licenses.** WMR Chapter II stipulates that all enterprises engaged in waste collection, transportation, recovery and disposal activities shall be registered in the waste managers register. In the registration certificate form (Annex VI) the enterprises have to specify their activities according to the types of waste management defined in Annex V WMR. The registration certificates are not issued. The waste managers register is kept by the Environmental Protection Agency in the Ministry of Environment. The main imperfection of WMR is that the registration of HZW generators is not compulsory.

Hazardous waste collection, transportation, sorting, disposal and recovery enterprises need a license on hazardous waste management. The Ministry of Environment issues licenses concerning hazardous waste. Enterprises have to submit a registration certificate form in the REPD together with the application for the license.

**Records keeping and reporting obligations.** WMR Chapter III stipulates that each company that is engaged in waste management activities and is registered as such in the waste managers register has to keep a primary waste recording log, using the form presented in Annex VII WMR. The same obligation applies to industrial enterprises that have more than 50 employees and carry out one of the economic activities listed in Annex X WMR. The obligated companies have to record, the waste accumulated before commencement of the log, waste codes and denominations, waste quantities generated, transferred, received or managed, type of management as well as source and recipient of the waste. Waste recording logs shall be submitted to the authorised officials of the Ministry of Environment, counties or municipalities upon their request. Since 1 January 2000 the records keeping is mandatory.

WMR Chapter IV builds the legal basis for the Lithuanian waste data collection system. Waste recovery and disposal companies as well as the companies importing or exporting waste are obliged to report annually on waste management issues, using the form of a national waste recording report Annex VIII WMR. Branches or divisions of an enterprise located separately have to fill in individual reports. The reports have to be submitted by 25 January of the following year. The first reports had to be submitted in January 2001 providing the data of the year 2000 [4].

## 2.3 Institutional framework

The Ministry of Environment (MoE) is the main institution responsible for legislation and administration in the field of waste management. The Ministry coordinates the activities of the State, regional and local institutions and has to prepare the national strategy waste management plan. The Ministry of Environment is responsible for the compilation of national waste statistics and for

reporting on the national level as a competent authority.

The State Environment Protection Inspectorate (SEPI) and the subordinated 8 regional environment protection departments (REPDs) carry out enforcement and control of waste management legislation. The regional departments are responsible for permits, environmental impact assessment, laboratory control and enforcement of environmental regulations. To carry out these functions, they have a centrally based core staff and agencies at the district or city level. The agencies are responsible for environmental inspections.

The Environmental Protection Agency (EPA) has been founded only recently by merging the former Joint Research Centre and the Department of Management of Water Resources. The EPA is subordinated to the Ministry of Environment. The latter has taken over the responsibility for environmental monitoring in general and for waste data collection in particular from the Joint Research Centre. The EPA is also involved in the preparation of legal acts [4].

Ministry of Economy is responsible for National hazardous waste management programme arrangement and implementation. The Ministry prepares and confirms the waste prevention programmes, coordinates activities and HZW management of industrial enterprises and initiates appropriate HZW management possibilities.

## 2.4 Waste information collection

With the adoption of the waste management regulations in 1999, Lithuania changed its system of waste data collection. By then, the data were collected from waste generators and collectors, whereas the new system is based on the annual reports of waste recovery and disposal companies as well as the companies who import or export waste. Obligated parties have to fill in the national waste recording report that covers the following items:

- source of waste (geographical code of waste origin, code of industrial origin (NACE), name of waste producer);
- waste characteristics (code of statistical waste classification and code according to a waste list, name of waste);
- quantity of waste (quantity accumulated at the beginning of the year, quantity received from elsewhere over the year, quantity managed over the year);
- treatment operation (code and name of a treatment method according to the Lithuanian list of waste treatment types).

The local agencies collect the data for the regional environment protection departments (REPDs). The agencies carry out an initial manual checking of the reports. Data entry into electronic data sheets and verification are done by the REPDs. The electronic data sheets are forwarded to the

Environmental Protection Agency for additional verification and final data processing. A summary of the results is published in the annual reports on the State of the Environment by the Ministry of Environment.

The old data collection system had been in place since 1993 and the last reports according to the old system for the year 1999 were due in January 2000. The first survey following the new approach was conducted in 2001 referring to the year 2000.

Currently, the Lithuanian waste data collection system faces several problems with regard to compliance with the reporting requirements of the EU waste statistics regulation and the OECD/Eurostat joint questionnaire (JQ), namely:

- The two Lithuanian waste classification systems do not comply with the latest versions of the European classifications (EWL and EWC-Stat2) yet;
- It is difficult to assign the waste to the generating sectors because the annual reports of the waste treatment and disposal contain insufficient information on the origin of waste;
- Lithuanian waste data collection system does not omit the main function: it does not give the information about the real amount of HZW generating in Lithuania. The system only gives the data about the part of HZW waste, whose generators of waste are requested to transfer for the third person;
- The definitions of recovery and disposal operations in the Lithuanian waste management regulations are not in line with the definitions of the waste framework Directive [4].

## 2.5 Hazardous waste generation and treatment in Lithuania

For the years 2000 and 2001, the data reported to Eurostat distinguish municipal waste and waste of other origin. In the following, the waste of other origin is referred to as industrial waste although the originating sectors are not specified. Before 2000, the data on waste generation were collected from waste generators and collection companies. However, mining and quarrying are the only industrial activities for which the generated waste amount was specified. It has to be pointed out that Lithuania reports no figures on the total waste generation in Lithuania because the available data are considered to be incomplete.

Fig. 1 shows the generation of industrial waste in the period between 1992 and 2004. The figure indicates a decreased amount of industrial waste at this period. The introduction of a new data collection system and the change of waste classifications in 2000 caused a break time series. The generated amount dropped and increased again in the following year. These fluctuations are apparently due to the introduction of a new data collection system. It will

take some time before the new system is established and will produce reliable results [17].

In 2001, hazardous waste generation in Lithuania amounted to 111 000 tonnes which corresponds to 32 kg per capita. The Mažeikiai Oil Refinery dominates hazardous waste generation. The refinery generates up to 50 % of the hazardous waste total. A major part of the generated waste is oil/water mixtures, emulsions and other waste oils. In 1999, oil containing waste in Lithuania amounted to 56 800 tonnes and accounted for 54 % of the hazardous waste total.

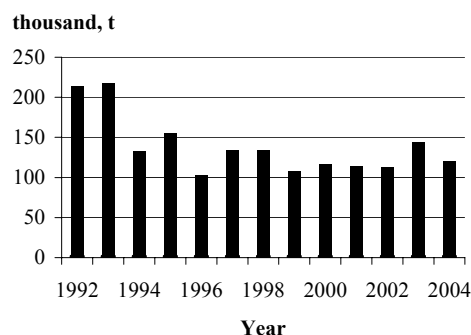


Fig. 1. Development of hazardous waste generation in Lithuania

Fig. 1 shows the development of hazardous waste generation since 1992. During the last 10 years the hazardous waste total decreased considerably. From 1992 to 2001 the generated total nearly halved. This development mainly results from a sharp decrease in oil and tannery wastes. Oil containing waste generation declined from 109 900 tonnes in 1993 to 56 800 tonnes in 1999. In the same period, the amount of tannery waste fell from 14 800 tonnes in 1993 to 1 200 tonnes [4].

According to the National Waste Accounting database and Register of Waste Management the total amount of hazardous waste generated in Lithuania in 2004 is 118 thousand tonnes (34.5 kg per capita). Including the amount of waste generated in private companies during various years; the total amount of treated hazardous waste is 139 thousand tonnes in 2004. Fig. 2 shows a total amount of hazardous waste generated in Lithuania in 2004 according to the hazardous waste classification.

Major parts of generated waste in 2004 are wastes from, petroleum refining, natural gas purification and pyrolytic treatment of coal (46.2 %), oil wastes and wastes of liquid fuel (33.38 %). The Mažeikiai Oil Refinery and Klaipėda Oil Refinery, dominate hazardous waste generation. The fewer amounts of HAZ wastes are wastes from chemical surface treatment and coating of metals and other materials (5.97 %), construction and demolition wastes (including excavated soil from contaminated sites) (5.47 %).

The treatment of hazardous waste in Lithuania for the year 2001 as reported in Eurostat showed a very high recovery rate of nearly 76 % (84 000 tonnes). A minor share of 2.7 % (3 000 tonnes) was

energetically recovered. The reported quantity of hazardous waste designed for final disposal is very low and amounted to only 5 000 tonnes or 4.5 % of the generated total. The discrepancy between the

generated total and the sum of the treated waste (about 20 %) is mainly due to the temporary storage of waste.

Table 1. Total amount (%) of hazardous waste generated in Lithuania in 2004 according to hazardous waste accounting data performed with reference to waste classification list (Waste Management Regulation)

List of HZW	Generated (%)
01 Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals	0.14
02 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing	0
03 Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard	0
04 Wastes from the leather, fur and textile industries	0.03
05 Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal	46.2
06 Wastes from inorganic chemical processes	0.13
07 Wastes from organic chemical processes	0.07
08 Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks	0.47
09 Wastes from the photographic industry	0.12
10 Wastes from thermal processes	1.92
11 Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy	5.97
12 Wastes from shaping and physical and mechanical surface treatment of metals and plastics	0.1
13 Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)	33.38
14 Waste organic solvents, refrigerants and propellants (except 07 and 08)	0.04
15 Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified	0.71
16 Wastes not otherwise specified in the list	4.36
17 Construction and demolition wastes (including excavated soil from contaminated sites)	5.47
18 Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)	0.19
19 Wastes from waste management facilities, off-site wastewater treatment plants and the preparation of water intended for human consumption and water for industrial use	0.51
20 Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions	0.18

According to the report on the State of the environment 2000, the major part of the recovered hazardous waste is oil containing sludge from the Mazeikiai Oil Refinery. The sludge is treated in centrifuges. Then the separated oil is recycled to crude oil and the remaining sludge is treated biologically. In the year 2000 about 46 170 tonnes of oil sludge were recovered. The recovered amounts also include the cleaning of oil contaminated bilge waters (24 116 tonnes in 2000) and the biological treatment of oil contaminated soils (15 498 tonnes in 2000). In addition to the treated and disposed of quantities, a considerable amount of hazardous waste is temporarily stored in Lithuania. The respective quantities have increased in recent years. In 2000, the stored volume amounted to 90 000 tonnes and was nearly as high as the generated total. About 2 000 tonnes of hazardous waste had to be exported in the year 2000. Lead batteries constituted the major part among the exported wastes.

In a joint questionnaire Lithuania reports that in 2001 hazardous waste was treated and disposed of in 26 treatment plants and 27 incineration plants. However, these facilities are not specifically designed for the handling of hazardous waste. In addition, hazardous waste is treated and incinerated together with non – hazardous waste in seven treatment facilities and in seven incineration plants [17]. For the permanent storage of hazardous waste three facilities were in operation in 2001.

Note: There are still no official operational hazardous waste incineration plans in Lithuania. The incineration plant for HZW is under construction.

Lithuania is currently improving its infrastructure for hazardous waste management. In 2001 a regional hazardous waste storage site was constructed in Šiauliai. Similar storage sites are being put in place in Alytus, Klaipėda and Vilnius. According to the *acquis* implementation plan, Lithuania plans to design and construct an incineration plant and a landfill site for hazardous

waste. The incineration plant shall start its operation in 2006 to 2008. Fig. 2 shows treatment and disposal of hazardous waste in Lithuania in 2001 – 2004. The

biggest amount of waste generated in 2004 is storage until the incineration plant and landfill for hazardous waste will start to operate.

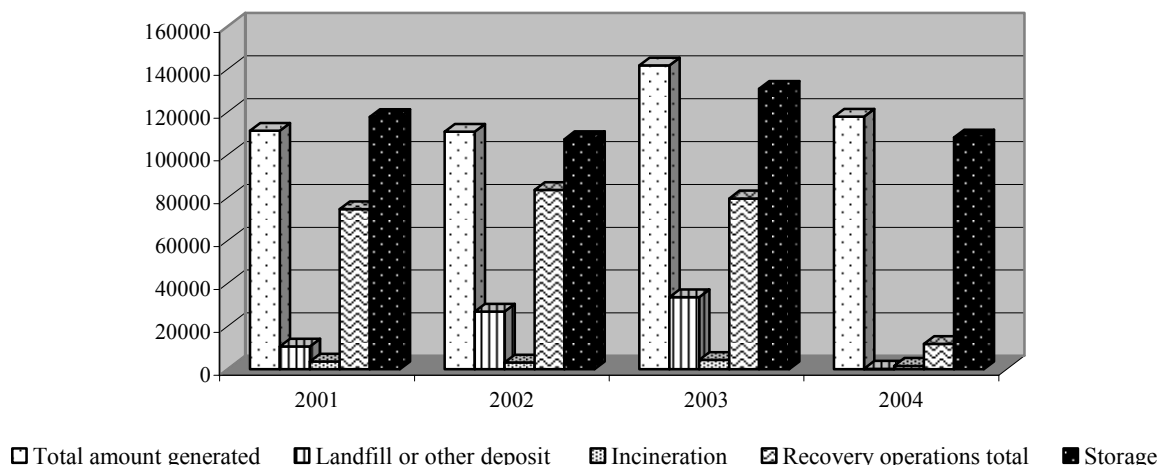


Fig. 2. Treatment and disposal of hazardous waste in Lithuania 2001 – 2004

## 2.6 Landfill management in Lithuania

The landfills are divided into three classes - hazardous, non-hazardous and inert waste, accordingly The Landfills Directive (1999/31/EB), whose requirements are transferred to the base of Lithuanian Law legislation: “The rules on landfilling installation, maintenance and after-care provision” [16]. Hazardous waste can be disposed only in the hazardous waste landfills. It is planned in the National Strategic Waste Management Plan to close all landfills until 2012, which falls short of the environmental requirements and to manage the waste by a regional principle. It is planned to establish eleven regional waste landfills: ten for non-hazardous and one for hazardous waste.

The analysis of the National Environmental Inspection data on the waste system violation showed that 21 % from 896 violation cases of the Law on Waste Management is pollution with hazardous waste. Only a few violations were registered as illegal. The fine for illegal dumping with hazardous waste was 300 – 500 Lt [information on March, 2006].

## 2.7 Hazardous waste management costs

According to the information given by the National Environment Protection Inspection, there are 236 licensed private companies (information on June, 2006), which can manage hazardous waste in Lithuania. The considerable amount of HZW is treated in the Lithuanian State owned companies (“Toksika” Ltd, “Eisrega”, Ltd “Klaipėdos krašto tvarkymas” and “Švarus Vilnius”Ltd).

The costs of hazardous waste management for a holder depend on a HAZ waste type, chemical constitution, and applied technology for HAZ treatment (information on May, 2006).

The tariffs for hazardous waste treatment in “Toksika Ltd are:

- Oil wasted soil – 224.2 Lt/m<sup>3</sup>;
- Waste paint and waste from removal of paint and varnish – .0.98 Lt/kg;
- Electrolyte – 1.50 Lt/kg;
- Dry voltaic cell – 2.85 Lt/kg;
- Waste from solvents – 1.5 Lt/kg;
- Fluorescent tubes – 1.18 Lt/unit.

The other companies use different tariffs for treatment of hazardous waste. There is no centralized system to determine the tariffs for HZW treatment in Lithuania. The prices for hazardous waste treatment in “Toksika”Ltd are similar to the prices in Denmark, Netherlands and the other EU countries.

## 2.8 Technologies for hazardous waste treatment and their capacity

According to the prognosis of hazardous waste generation in Lithuania [5] the main conclusions should be made:

- The most part of HZW can be utilized using physical – chemical processes. A big amount of hazardous waste can be managed when the incineration plant for hazardous waste is set up;
- The part of HZW which cannot be utilized using physical-chemical processes should be disposed in the landfill for hazardous waste. Disposal of HZW is possible after special preparation or taking into account that disposal is one of the cheapest ways for HZW management in Lithuania;
- With the object of reducing the amount of HZW generated in Lithuania, the attention should be focused to the integrated hazardous waste management. With reference to a pyramid of waste hierarchy the prevention and reduction of waste is given the priority, then goes its reuse

and recycling and the last but not the least is the optimisation of its final disposal. The prioritisation of HZW is possible only if it is economically efficient.

The data representing the prognosis of hazardous waste generation, desirable technologies for HAZ waste treatment and their capacity in Lithuania are given in Table 2.

Table 2. Prognosis of hazardous waste generation and desirable treatment technologies in Lithuania, 2005 – 2008

Technological flow of hazardous waste	Stored, t	Annual amount, t 2005	Prognosticated amount, t 2008	Desirable technology	Comments
Oil wastes (non halogenic)	2 000	3600	14 000	1. Regeneration - 60% 2. Recycling for fuel - 30% 3. HAZ incineration - 10%	1. Capacity is enough 2. Requires capacity improvement 3. Requires capacity improvement o
Oil wasted soil, sludge etc.	126 000	82 000	85 000	1. Biodegradation - 99% 2. Other physical – chemical processes - 1%	1. Capacity is enough 2. Not enough capacity
Bilge oils	5 000	52 000	60 000	1. Oil catchers - 95% 2. Other physical – chemical processes - 5%	Improvement of physical - chemical processes operation
Halogenic oils and other hydrocarbons wastes	100	150	150	1. Export or incineration in Lithuania	1. No capacity 2. Export is feasible 3. Export of tainted equipment
Medical wastes	?			Incineration	Necessary to incinerate disinfected medical wastes (about 2 000 t)
Pharmaceutical wastes	100	?		Incineration	Capacity is
Wastes containing heavy metals or other HAZ chemical substances	2 000	2 000	2 500	1. Thermostabilisation- 50%-60% 2. HAZ landfill -30%-35% 3. Stabilisation, HAZ landfill - 10%-15%	1. Capacity is, enough, the quality of atmosphere protection is to be improved 2. Set up landfill for HAZ waste 3. Set up stabilization equipment
Batteries and accumulators	100	6 000	7 000	1. Regeneration and export -60% 2. Export without regenerations - 40%	1. Development of capacities effectiveness 2. Development of export accounting
Discarded electrical and electronic equipment, cars equipment	?	?	2 000?	1. Physical – chemical processes - 70% 2. HAZ landfill - 30%	1. Development of capacities effectiveness 2. Development of new regeneration capacity 3. Landfill for HAZ waste
Tainted soil (excluding oil products)	?	100?	500?	1. Physical – chemical processes	No capacity. After the stabilisation possible limited usage.

? – the amount of HZW is not known or inaccurate

### 3. Improvement of hazardous waste management system

Having analysed the hazardous waste management system in Lithuania, there were defined its main problems, namely, imperfection of HAZ waste identification system, insufficient sorting of hazardous waste at its source, illegal disposal, incompletely strict and qualified HAZ waste control, and economical difficulties in trying to keep up to the requirements of the HAZ waste management.

It is important to consider that municipalities are responsible only for household hazardous waste management. Therefore, industrial hazardous waste producers are responsible for their own generated

waste management. The society is to be informed about hazardous waste damage for environment, human health environment when improperly treated, stored, transported, disposed, or otherwise managed. In pursuit of reducing the amount of hazardous waste generation, the principles of waste hierarchy are to be followed. In the waste hierarchy, waste prevention is preferable to recycling, recycling is preferable to incineration with energy recovery, and the landfilling is at the bottom of the “ladder”. Hazardous waste prevention is placed at its top. Pollution prevention includes taking different measures: waste minimization, cleaner production, ISO 14000 standards, eco – design, etc.

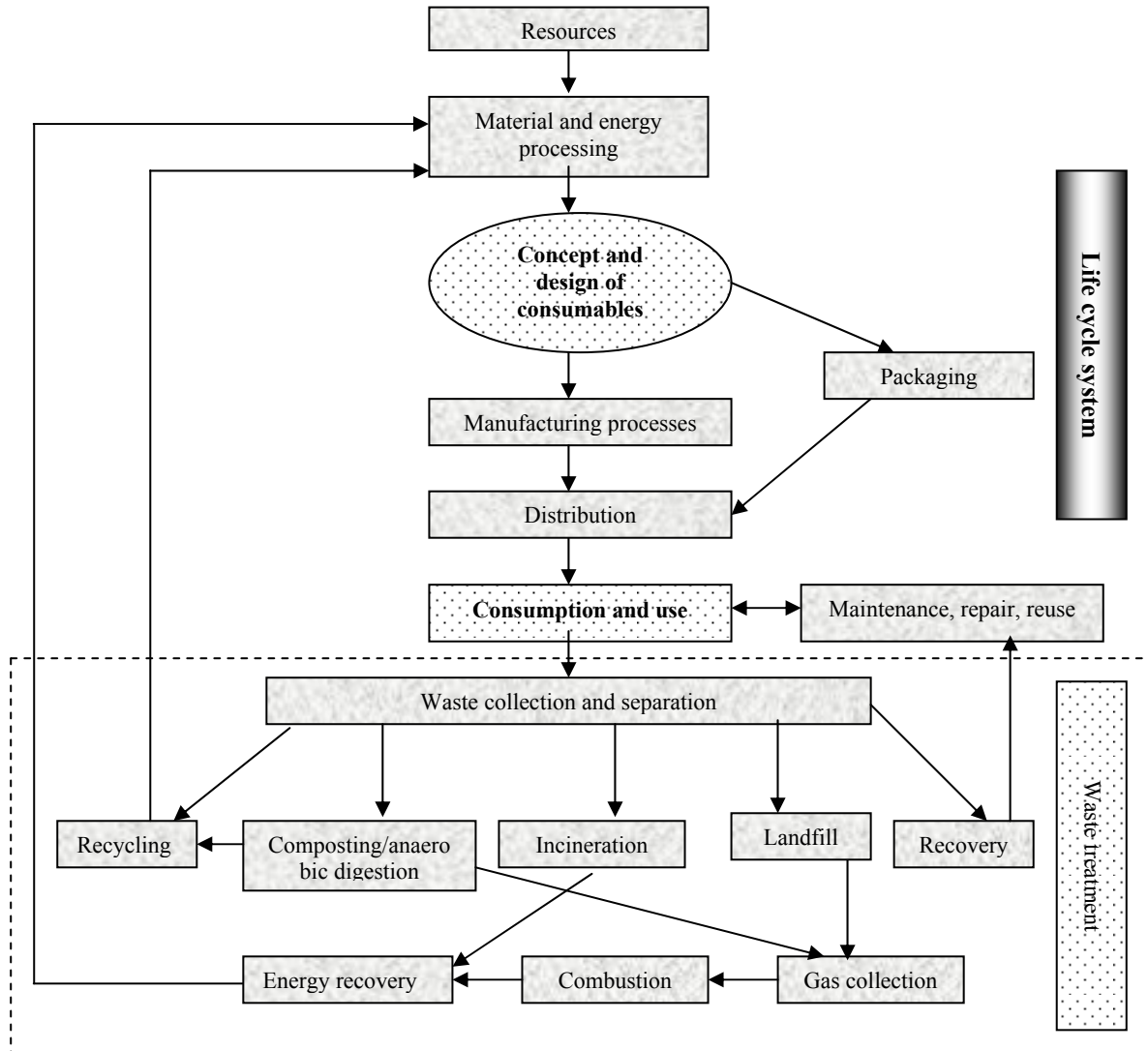


Fig. 3. Schematic hazardous waste system life cycle [16]

Life cycle assessment can be used in eco – design and defined as a method that studies the environmental aspects and potential impacts of a product or system from raw material extraction through production, use and disposal. General categories of environmental impacts to be considered include resource use, human health and ecological consequences

The result of an LCA is an environmental profile that expresses the performance of the total system life cycle and single life cycle stages. It is a recognized tool in decision making within industry and public administration. The data on waste treatment processes still tend to be missing or are of poor quality. As can be seen from Figure 3, the environmental impacts of the hazardous waste system depend on three system characteristics:

- **The concept and design of the products** ending up as waste have an influence on the type and amount of material the products consist of, on their lifetime. They also affect the degree the products are recyclable and non-hazardous, and

the degree they can be dismantled into recyclable fractions.

- **Consumption patterns** influence the municipal waste flow because it is the consumers who buy the consumables that flow through the system and they partly decide the consumables lifetime.
- **The hazardous waste treatment** decides to what extent the waste shall be distributed between the treatment alternatives and the technology and efficiency of the treatment options.

About 80 % of environmental problems can be solved during the design processes. The use of preventive measures in certain companies – is another important aspect improving the hazardous waste management system. The preventive measures are urgent in the activities of all participants.

Any changes in the system will be inefficient, if participants lack the adequate information and training. The information sources are proposed to ensure the delivery of information: the regional centers of waste management are desirable. The information: conferences, seminars, reports on methods; and the content of information could be: the



knowledge about sorting of hazardous waste at the source (households), preventive means application in manufacturing, possibilities of regeneration, recycling, etc. The information should involve all participants to hazardous waste management system. The most important problem is shortage of technical requirements for HZW treatment. The technical requirements should settle the HZW treatment results and measures to achieve them. With no exact requirements the participants of HZW system are left ignorant, the HZW management can not perform their work.

#### 4. Conclusions and recommendations

Recapitulating the results of the research on the hazardous waste management system the following conclusions could be made:

- Lithuanian hazardous waste management system has been unable to avoid some shortcomings. As one of its problems is its incomplete hazardous waste identification system. It presents difficulties in prognosticating the amount of hazardous waste which results in problematic design technologies and their capabilities.
- HZW is not accurately estimated in Lithuania; consequently, the amount of properly treated HZW is not accurate (Table 2).
- Sorting of hazardous waste is neither performed at its source nor it is assured.
- Picking up and delivery of hazardous waste for treatment are facing a lot of obstacles
- Illegal disposal is still working due to high treatment costs.

Taking into account the problems determined during the analysis of the hazardous waste management system, the following suggestions are proposed:

1. The approach of an effective hazardous waste management system in Lithuania should be based on three principles:
  - *Waste prevention*: It is a key factor in the waste management strategy. Reduction in the amount of generated hazardous waste is of utmost importance. Reduction in its hazardousness by reducing the presence of dangerous substances in products automatically simplifies its disposal. Waste prevention is closely linked with improvement of manufacturing methods. Consumers are to be taught to require hazardous materials free products and less packaging. HZW prevention cannot be implemented without the requirements for eco-balance in the manufacturing industry.
  - *Recycling and reuse*: In cases when hazardous waste cannot be prevented, the materials, as many as possible, should be recovered - preferably by recycling. The European Commission has defined several specific

“waste streams” for the priority attention, the aim being to reduce their overall environmental impact. With no technical requirements for HZW stabilization, the treatment and disposal of HZW will remain at the level they are today.

- *Improvement of final disposal and monitoring*: In case hazardous waste cannot be recycled or reused it should be safely incinerated, with a landfill used as an only last resort. Both these methods need close monitoring because of their potential for causing severe environmental damage. The system should be improved by developing an identification system of hazardous waste.
2. Exact and strict preventive measures should be adopted for specific private companies.
  3. Taxes and fines system should be balanced. The waste management costs in landfills should be higher than those in recycling companies.
  4. Training, information should be ensured to the participants of the system, environmental consciousness is to be developed and spread more extensively.

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## **Pavojingų atliekų vadybos sistemos Lietuvoje analizė ir jos gerinimo galimybės**

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Straipsnyje analizuojama Lietuvos pavojingų atliekų (PA) vadybos sistema. Atsižvelgiant į tai, kad remiantis Europos Sąjungos reikalavimais, nuo 2012 m. Lietuvoje numatoma uždaryti apie 800 šiuo metu veikiančių sąvartynų ir įrengti 11 modernių regioninių sąvartynų [13], labai svarbu išanalizuoti ir įvertinti Lietuvoje susidarančių PA kiekius, tvarkymui reikalingas technologijas bei jų pajėgumus. Tyrimai atlikti remiantis Valstybinės atliekų apskaitos duomenimis, Regionų aplinkos apsaugos departamentų ataskaitomis (2004 m.), Lietuvos statistikos departamento, Eurostat „New Cronos“ duomenų bazėmis.

Remiantis gautais rezultatais, galima teigti, kad PA vadybos sistema nėra efektyvi dėl keletos pagrindinių priežasčių – pavojingų atliekų identifikavimo sistemos netobulumo, nepakankamai kvalifikuotos ir griežtos PA kontrolės ir ekonominių sunkumų, bandant laikytis reikalavimų tvarkant mažus PA kiekius. Dėl PA identifikavimo sistemos netobulumo sunku numatyti susidarančių PA kiekius, jų tvarkymui reikalingas technologijas bei jų pajėgumus.

Atsižvelgiant į tyrimų metu nustatytas pagrindines problemas, sistemai gerinti siūloma naudoti teisinės, ekonominės ir politinės priemones. Siūloma vystyti pavojingų atliekų identifikavimo sistemą, įsteigti nepriklausomas laboratorijas PA nustatyti, įstatymais įteisinti reikalavimą įmonėms, generuojančioms PA, deklaruoti jų veikloje susidarančių PA kiekius, skatinti prevencinių priemonių (ekologinio gaminių projektavimo, švaresnės gamybos, Aplinkos vadybos sistemų) naudojimą visoje PA dalyvių veikloje, užtikrinti tinkamą sistemos dalyvių mokymą, informavimą, ugdyti aplinkos apsaugos sąmoningumą.