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**ENVIRONMENTAL COSTS MANAGEMENT  
IN ENTERPRISES OF CHEMICAL INDUSTRY**

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*At present, it is necessary to trace, track and evaluate environmental costs of enterprises. Today's environmental compliance costs are huge and still increasing for many enterprises, and the costs of the information systems tracing environmentally related costs are relatively small compared to those of not tracing. Tracing, tracking and evaluating of environmental costs have gained importance for the correct calculation of the profitability of products, production sites and enterprises. The knowledge of environmental costs and their transparency represent the basis for taking environmentally relevant facts into consideration in decision making. The article summarizes the results of the research that was carried out in enterprises of chemical industry in the period of 1996 – 1999.*

## Current Situation of Problem

We can see rising interest of improving quality of environment in recent years. Governments of all countries, enterprises and every individual are responsible for the state of environment. The main trend of economically advanced countries (but also the Czech Republic) is especially controlling of industrial enterprise's impacts on environment. Enterprises are, therefore, focusing on the control of impacts of their activities, products or services on the environment. Sustainable development and reserving of the possibility of further development and prosperity with efficient use of natural resources are becoming their priorities. Chemical industry belongs among industrial branches that significantly participate in pollution of the environment.

Enterprises have many, especially voluntary, opportunities and activities how to improve environmental performance. Activities are supported by international environmental policy and by policy of European Union. Implementation of projects of clean technologies, production of ecological products and, last but not least, innovation of management systems with respect to environmental protection, the so-called environmental management systems (EMS), belong among those voluntary activities.

Incorporating of requirements on environmental protection into business activities is the principle of environmental management.

Environmental management's aim is introduction of requirements on environmental protection into enterprise's management system. The result must be a permanent economic growth and prosperity of business and elimination of negative impacts of business activities, products and services on the environment. The knowledge of the basic principles of EMS becomes prestigious matter for top management of enterprises. EMS belongs among tools that enable creation of better market position of an enterprise.

The starting point for decision making within environmental management should lie in an adequate information system. Fundamentals of the information system for environmental management are systematic collecting, recording, analysis, evaluating and reporting of data about enterprise's environmental performance. In my opinion, information about environmentally induced financial impacts as well as information about costs associated with the environmental protection and prevention of pollution, i.e. environmental costs, should be a part of environmental information system. This kind of information is interesting for potential shareholders (it helps them to decide where to invest their funds), creditors, banks (helps with granting a credit), insurance companies (helps with insurance against business risks), customers, public and other stakeholders.

Enterprises of chemical industry as ones of the significant pollutants of the environment have not created environmental information system. No appropriate attention was paid even to monitoring and analysis of environmentally induced

financial impacts. This article is, therefore, focussed on that part of information system which deals with *collecting, recording, evaluating and reporting data about environmentally induced financial impacts*. Very strong attention is especially paid to environmental costs. The current information system of most of the enterprises enables to directly obtain only information about some selected environmental costs. However, larger part of environmental costs is hidden in total costs entries (for example: material consumption, energy consumption, depreciation of tangible and intangible fixed assets, repair and maintenance expenses, and the like) and overheads. Next problem of large enterprises of chemical industry is the way of allocation of environmental costs to the “responsible” cost centers and cost carriers (i.e. a particular plant or product). Environmental costs are considered as overhead costs and are allocated to products and cost centers according to keys which are currently applied to particular types of overheads. The allocation is mostly based on incorrect input data, and then the result is incorrect costing, for example: cost accounting of products-management’s decision is based on incorrect information. Information about environmental costs are utilized neither in investment decisions, nor in decisions about new products and technologies.

The article summarizes the knowledge and results of research that was carried out in the period of 1996 – 1999. Its suggestions and deductions are based on solving to partial projects of environmental accounting in several operation plants of the enterprise Synthesia Pardubice.

## Results

The idea of sustainable development, i.e. development of the world conditioned by preservation or possibly improvement of the environment, is the only alternative for further existence of mankind. Industrial enterprises have *very significant and uninterchangeable role* in the environmental protection.

Managers and owners of enterprises are very well aware of necessity to include environmental protection matters into business strategies and planning, so they are able to stand competitive environment. The result of responsible approach to the environment is on the one hand contribution to continual economic growth and prosperity of the enterprise, and on the other hand progressive mitigating of adverse impacts of enterprise’s activities, products or services on the environment.

Conclusions resulting from the research:

*1. It is necessary to integrate environmental protection and prevention of pollution with overall management system of an enterprise*

It is very important to implement an environmental approach into overall

management system of an enterprise, so we are able to incorporate environmental protection into business practice. The overall aim is to support environmental protection and prevention of pollution in balance with socio-economic needs. Within environmental management system, it is necessary to incorporate environmental protection into business strategy. Environmental protection must become a part of managerial tasks and decision making on tactical and operative levels. Environmental aspect must be integral part of all phases of control cycle. It has to be included in planning, organizing, ordering, regulation, checking. Environmental protection must be implemented in all enterprise's activities and on all organization levels.

*2. For effectively functional environmental management it is essential to devise an information system (about this problem in greater detail, see Ref. [3])*

The background of every managerial decision making is information analysis. The analysis is always based on information system which is created according to management needs. In my opinion, environmental information system is a basis of managerial decision making within environmental management system. This information system must be created for purposes of environmental management. Considering various information needs of different stakeholders inside and outside of an organization (i.e. different information users), there are following information subsystems within environmental information system: (see Fig. 1)

- environmental accounting,
- information about ecological impacts of enterprise's activities, products or services (this subsystem can be called ecological accounting),
- additional information (for example: legislation, standards, regulations).

These subsystems must *link to each other* and must *pass information to each other*, so functional information system for environmental management can be created. Integration of subsystems is very significant for effective environmental management of an enterprise. Information system for environmental management must be created in the way to provide information for important stakeholders and to assist an enterprise in improvement of its environmental performance and then to continue to approach of sustainable development. Information system for environmental management is very an important tool which has particular strengths in supporting specific functions of environmental management. Furthermore, it is also obvious that every comprehensive environmental management concept aimed at supporting real improvement must rely on environmental information system. Environmental information system supports information management, i.e. collection, analysis and decision, with environmentally induced financial data as well as with information on environmental impact added. The aim of the system is to locate places, products, activities and processes that pollute the environment and cause economic loss.

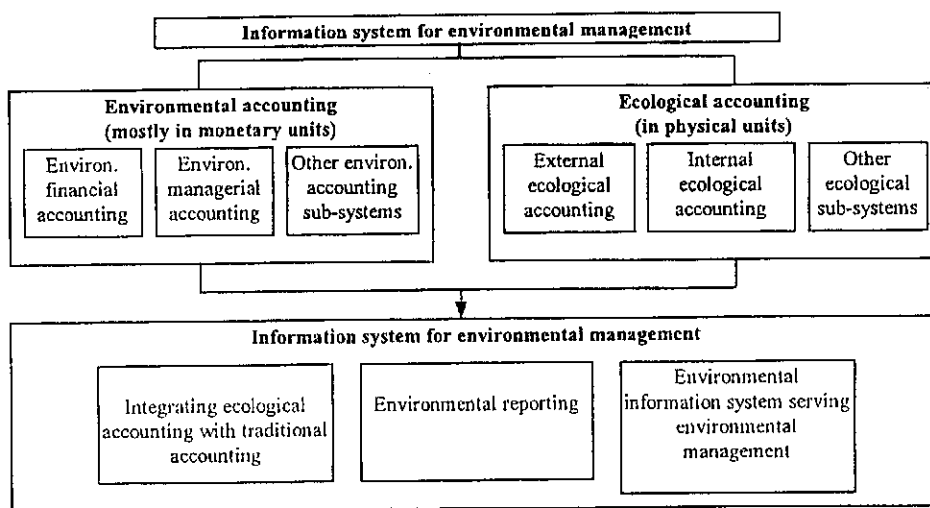


Fig. 1 Information system for environmental management

3. *Environmental accounting is a significant source of information about environmentally induced financial impacts (about this problem in greater detail, see Refs [2–5])*

*Environmental accounting* is, in my opinion, a significant part of information system for environmental management. We suggest the following definition of environmental accounting [2]: Environmental accounting is a sub-area of accounting that deals with collecting, recording, evaluating and reporting information about environmentally induced financial impacts of an enterprise (= subject of environmental accounting). Environmentally induced financial impacts are impacts (expressed in monetary units) on

- costs and revenues (i.e. on economic result) or income and expenses of an enterprise,
- assets and liabilities of an enterprise which are coherent with impacts of its activities, products or services on the environment.

Not all environmentally induced financial impacts are internalized and considered in the traditional accounting system of the enterprise which caused them. Pollution of the environment is an example of the so-called negative externalities. Externalities represent the costs of business' impacts on the environment and society for which business is not legally accountable. Externalities include both (1) environmental degradation for which enterprises are not legally liable and also (2) adverse impacts on human beings, their property and their welfare (e.g., employment impacts of spills) that cannot be compensated through the legal system. For example, damage caused to a river because of polluted waste water discharges, or

to ecosystems from solid waste disposal, or to asthmatics because of air pollutant emissions are all examples of externalities for which a business often does not pay. It is necessary to include financial impacts which an economic subject causes to other economic subjects (externalities) into environmental accounting.

*4. Within environmental management, it is necessary to pay attention to costs which represent advisable use of economic resources that were used up with the aim of mitigating of adverse impacts of enterprise's activities, products or services on the environment (about this problem in greater detail, see Refs [1,2])*

The process of identification, measurement, accumulation, analysis, preparation, interpretation and communication of information about environmental costs forms a part of environmental accounting. In the case of definition of environmental costs, we suggest to use the basic definition by Vaněček [5]: Enterprise environmental costs are costs connected with enterprise's actions (investments, projects, ...) and those activities (waste disposal, prevention of waste emergence, operation of health care equipment, ...) whose aim is to minimize the adverse impacts of the enterprise on the environment. Within environmental costs it is necessary to differentiate between investment costs and ordinary costs (operating, financial). We understand environmental investment costs as means for renewal, expansion and improving of productive and non-productive assets which are expended with the aim of mitigating of adverse impacts of enterprise's activities, products or services on the environment (for example: costs of construction of waste water treatment plants, incinerators, separators, and the like). Environmental ordinary costs represent expended means in coherence with ordinary (operating and financial) activities of an enterprise which are implemented with the aim to mitigate adverse impacts on the environment (for example: operating expenses of waste water treatment plant, incinerator, costs of recycling facilities, and the like).

*You can see the significance of environmental costs within environmental management in the following facts:*

- they enable to show positive and adverse impacts of an enterprise, its activities, products or services on the environment,
- information about environmental costs can be used for calculation of economic effectiveness of investment projects of an enterprise,
- dynamics of their development refers to overall standard and efficiency of enterprise's environmental management,
- they draw attention to factors and places (or products, processes, activities) which partake significantly in pollution of the environment,
- their analysis can be used as initial information for suggestions of appropriate strategies and tactics of environmental management of an enterprise,
- information about environmental costs is an integral part of reports about enterprise's impacts on the environment through which stakeholders are

- informed about environmental behaviour of an enterprise,
- tracking, tracing and evaluating of environmental costs enables comparison of attained objectives in the field of enterprise's environmental performance with given objectives,
- they serve as one of criteria for measurement of performance of enterprise's environmental management,
- they indicate possibilities of reduction of total costs and possibilities of improvement of profits of an enterprise,
- many environmental costs can be significantly reduced or eliminated as a result of business decisions, ranging from operational and housekeeping changes, to investment in "greener" process technology, to redesign of processes/products. Many environmental costs may provide no added value to a process, system, or product.
- better management of environmental costs can result in improved environmental performance and significant benefits to human health as well as business success,
- understanding the environmental costs and performance of processes and products can promote more accurate costing and pricing of products and can aid enterprises in the design of more environmentally preferable processes, products and services for the future.

*5. It is necessary to trace, to track and to evaluate environmental costs and to utilize gained knowledge for suggestions and realization of corrective actions*

We suggest to create and to use detailed and dynamic system of evidence and processing of data that are necessary for obtaining a picture about behaviour of environmental costs, in enterprises whose activities, products or services have adverse impacts on the environment (it is applicable also to enterprises of chemical industry). *Environmental costs program should have the following stages* (see Fig. 2):

- examination of justification to work with environmental costs,
- assurance and commitment of top management,
- formation of methodology for tracing, tracking and evaluating of environmental costs,
- collecting of information about environmental costs,
- tracing, tracking and quantification of cost items,
- analysis of environmental costs,
- suggestions and realization of corrective actions.

The first three stages are one-shot activities and must be completed before starting of routine environmental costs tasks which arise from regular implementation of other four stages.

We suggest to utilize environmental costs programs in large, small and

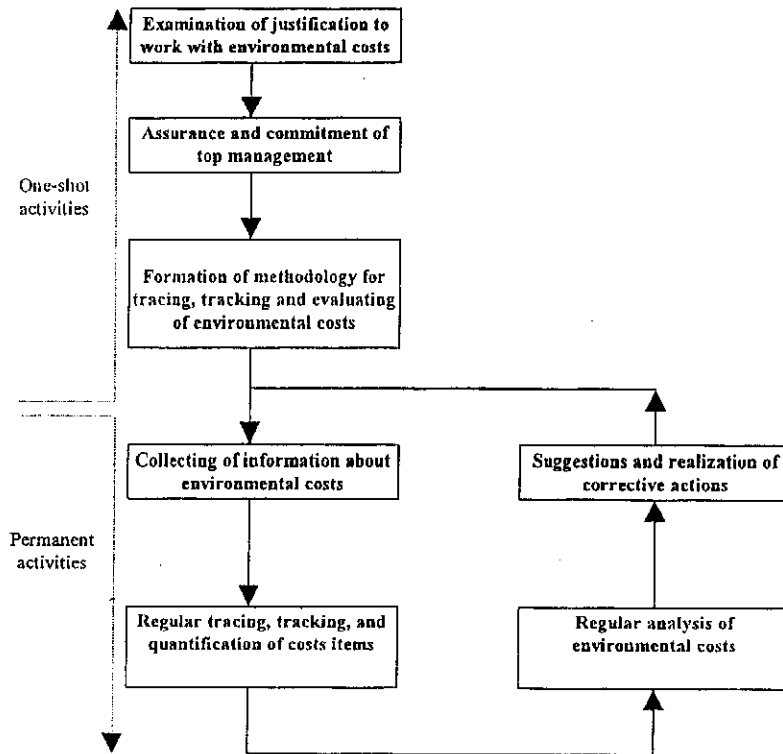


Fig. 2 Stages of environmental costs program in an enterprise

medium-sized enterprises of different industrial branches and service sectors. Depending on enterprise's needs, interests, goals and resources, environmental accounting can be applied on different scales which include the following:

- individual process or group of processes (e.g., production line),
- system (e.g., lighting, waste water treatment),
- product or product line,
- facility, plant, or all facilities at a single location,
- regional/geographical groups of plants or facilities,
- corporate division, affiliate, or the entire enterprise.

*Support of top management and assembling of cross-functional teams are necessary for successful implementation of environmental costs programs.*

*6. For implementation of environmental costs programs in enterprises it is necessary to introduce information about environmental costs into accounting system (about this problem in greater detail, see Ref. [2]).*



*Within financial accounting, we devise a modification of chart of accounts. After implementation of modification of chart of accounts it is possible to divide information about environmentally induced financial impacts (which are included in financial accounting) into two groups:*

- information about measures or facilities for the environmental protection that are used in an enterprise or are in a stage of preparation (construction),
- information about results of damage to the environment caused by an enterprise.

Environmental costs (introduced into financial accounting) express consumption of economic resources that were expended in connection with impacts of enterprise's activities, products or services on the environment with the aim of mitigating of adverse impacts. For including environmental issues into financial accounting it is necessary in detail to trace and to track *significant environmental costs*. We devise utilization of information about environmental costs, consequent on financial accounting, especially for high level of management – it is possible to trace, to track and to evaluate structure of environmental costs and their development trends, to compare environmental costs in particular enterprises. Information about environmental costs can be utilized for environmental reporting, for evaluation of effectiveness of EMS, and the like.

The purpose of introducing *environmental costs into managerial accounting* of an enterprise lies in solving following problems:

- A) specification of impacts of water conservancy system, air pollution and waste disposal on economic activity of an enterprise,
- B) specification of environmental costs for development of environmental management within an enterprise,
- C) tracing, tracking and evaluating of environmental costs especially according to output line and department line for needs of intradepartmental management.

A) Environmental pollution fees are high in enterprises of chemical industry. Enterprises should *trace, track and evaluate the above-mentioned costs with the aim of their reducing or eliminating*. "Saved" resources can be used for mitigating the impacts on the environment and, at the same time, for improvement of enterprise's environmental image. The main idea should be especially *prevention of waste production*, i.e. to replace end-of-the-pipe technologies by clean technologies. Material and energy flows that pollute the environment do not bring any profit—we have to pay three times for them—at purchase, processing during production and disposing.

B) For needs of environmental management of an enterprise, we devise to

differentiate between *investment costs* connected with environmental protection and *ordinary environmental costs*. Ordinary costs are then concentrated into groups which have specific predication ability for environmental management:

- *operating costs of environmental equipment* – the term environmental equipment means technology which is integrated into the production for environmental protection. The environmental equipment can be end-of-the-pipe technologies, for example. End-of-the-pipe technologies are clean-up devices which have been installed mainly for cleaning purposes after the core production process. They can help to concentrate toxic substances and to reduce toxic impacts. Clean technologies are more efficient production technologies which reduce pollution at source, or before it occurs.
- *costs for waste* – include costs for treatment and manipulation of waste, costs of its transport and depositing in landfills,
- costs that an enterprise must spend because of *pollution exceeded a limit given by law or another act*,
- *other costs* – for example: laboratory testing, analysis, costs of environmental department, and the like. Costs connected with establishing of EMS can be part of them – if necessary, it is advisable to detail these costs out of other costs and to trace and to track them separately.

We consider the following environmental costs division within establishing of EMS to be very useful for environmental management:

- *costs of prevention* – include costs of establishing and maintenance of EMS, costs of consultative services, costs of internal audits and certification of system, costs of improving in qualification within environmental management system, costs of various environmental analysis, costs connected with implementation of projects for continuous improving of environmental performance of an organization, *etc.*
- *costs of environmental verification* – we can add into this group the following: internal and external tests and controls, approval of new products, *etc.*
- *costs of mitigating and elimination of environmental impacts* – include costs of waste disposal, costs of waste water treatment plant, *etc.*
- *“external” environmentally-related costs* – these include fines and fees that usually result from violation of environmental laws.

This division of environmental costs is highly significant for environmental management of an enterprise. Total environmental costs of a specific time period have definite structure. If we compare time development of environmental costs, then it is important for environmental management to compare *development of structure*, for example: “external” environmental by-related costs should decrease

after establishing of EMS and also costs of prevention should increase, *etc.* Increase in costs of prevention should be demonstrated by decrease in costs of mitigating and elimination of environmental impacts, *etc.* It is evident that it is not sufficient for environmental management of an enterprise to know only total environmental costs but it is also necessary to deal with costs structure.

With respect to significance of environmental management systems, we suggest another view at environmental costs. Establishing and maintenance of EMS are very time demanding and expensive processes. For evaluation of effectiveness of EMS, it is necessary to define structure and volume of demands on establishing and utilizing of EMS, i.e. structure of cost items. *Costs of establishing and maintenance of EMS* can be divided into two groups:

- *costs of establishing and certification of EMS* – for example the following items belong in this group: costs of environmental reviews of starting environmental performance, advisory services, training, costs of technical monitoring, costs of certification, *etc.*
- *costs of EMS maintenance* – these include for example: costs of audits, costs of implementation of corrective actions, costs of implementation of preventive actions, costs of EMS development, *etc.*

The value (amount) of particular cost items depends on the size of an enterprise, its environmental performance, volume of advisory services and volume of already established component units for environmental protection.

C) Environmental costs are often hidden in overhead costs. Allocation of environmental costs to the right process, product, system, or facility is highly significant for managerial decision making. We suggest to separate environmental costs from overhead costs. After this, it is necessary to allocate environmental costs to the responsible process, product, system or facility. The obtained information is a starting point for decision making within environmental management. For costs of joint environmental centers we suggest allocation in two steps:

I<sup>st</sup> step represents allocation of costs from joint environmental cost centres to the responsible cost centres (i.e. production processes).

II<sup>nd</sup> step then represents allocation of costs from the production cost centers to the respective cost carriers (i.e. products).

*7. It is necessary to incorporate information about environmental costs into managerial decision making on strategic, tactical and even operative level*

We consider information about environmental costs to be a part of information system for environmental management of an enterprise. We devise *the following procedure for formation of system of tracing and tracking of environmental costs and utilization of information about environmental costs within environmental management of an enterprise:*

- to define environmental costs,
- to trace and to track important environmental costs,
- to allocate them to the responsible process, product, system or facility,
- to evaluate environmental costs,
- to integrate information about environmental costs with investment decision making,
- to apply environmental accounting to process/product design.

The knowledge of environmental costs and their transparency represent starting data for a lasting evaluation of the efficiency of products, production processes and for reliable planning of products and activities.

## Conclusion

Accounting for the environment has become increasingly relevant to enterprises because issues of the availability/scarcity of natural resources and pollution of the environment have become subjects of economic, social and political debate throughout the world. Steps are being taken at the national and international level to protect the environment and reduce, prevent and mitigate the effects of pollution. As a consequence, there is a trend for enterprises to disclose to general public data concerning their environmental policies, environmental management programmes, and the impacts of environmental performance on their financial performance. Accounting for the environment has become increasingly relevant to the stakeholders of an enterprise because the way in which an enterprise's environmental performance affects its financial health is of increasing concern to investors, creditors, governments and general public. In particular, disclosure of environmental data can be used to assess an enterprise's financial and environmental risk.

An enterprise which recognises its environmental responsibilities, and which institutes appropriate and effective systems of environmental management to ensure *inter alia* both competitiveness and compliance will minimise its exposure to future financial risk/loss arising from environmental incidents.

## References

- [1] EPA: *An Introduction to Environmental Accounting as a Business Management Tool: Key Concept and Terms*, (EPA 742-R-95-001) United States Environmental Protection, Office of Pollution Prevention and Toxics (MC 7409), Washington D.C. 1995.
- [2] Hyršlová J.: *Environmental Costs Management in Enterprises of Chemical*

- Industry* (in Czech), Ph. D. Thesis, University of Pardubice, Pardubice 1999.
- [3] Hyršlová J.: *Information System for Environmental Management of Enterprise* (in Czech), IV. International Conference "Economy and Informatics in the New Millennium", Liberec 1999.
- [4] Schaltegger S., Muller K., Hindrichsen H.: *Corporate Environmental Accounting*, J. Wiley and Sons, New York 1996.
- [5] Vaněček V.: *Environmental Accounting* (in Czech), Karolinum UK, Praha 1996.