B. GAJDZIK

ISSN 0543-5846
METABK 48(1) 63-67 (2009)
UDC – UDK 502.5:669(438):669.013.5(438):628.5:389.64=111

ENVIRONMENTAL ASPECTS, STRATEGIES AND WASTE LOGISTIC SYSTEM BASED ON THE EXAMPLE OF METALLURGICAL COMPANY

Received – Prispjelo: 2008-02-08
Accepted – Prihvaćeno: 2008-04-15
Review paper – Pregledni rad

The aim of this article is to present the key elements of environmental management system in metallurgical companies. This companies in use the Cleaner Production Strategy. All modern strategies are based on dynamic environmental model. Production processes still create waste and pollution although a significant amount is now recycled. For example in metallurgical companies located in the Polish market about 80% of solid waste is recycled. The minimization or complete removal of damages caused by metallurgical production are a necessary and important aspect of maintaining a competitive edge.

Key words: environmental aspects, metallurgical company, waste logistic system, recycling

Aspekt okoliša, strategija i logistički sustav otpada utemeljen na primjeru metalurške tvrtke. Cilj članka dati je ključne elemente u sustavu menadžmenta okoliša u metalurškim tvrtkama. Ove tvrtke rabe čistu Proizvodnu Strategiju. Sve moderne strategije se temelje na dinamičnom modelu okoliša. Proizvodni proces uvijek daje otpad i onečišćenja, koja se sada u značajnoj mjeri recikliraju. Npr. u metalurškim tvrtkama u Poljskoj oko 80% čvrstog otpada se reciklira. Minimalizacija ili cijelovito odstranjivanje opasnosti uzrokovane metalurškim procesima je važan i neophodan aspekt održavanja konkurentnosti.

Ključne riječi: aspekt okoliša, metalurška tvrtka, logistički sustav otpada, recikliranje

INTRODUCTION

The environmental management appeared in the late first half of the 20th century. The term of environmental management mainly refers to an environmental management system integrated with the general management system. The Environmental Management System comprises an organisational structure, planning, responsibilities, rules of proceeding, procedures, processes and measures used to develop, implement, analyse and maintain the environmental policy [1]. The structure of environmental management is presented in the international standard ISO 14001. The environment management tends towards eliminating negative impact (pollution prevention). It is based on the analysis of environmental aspects and their influence on the environment. An analysis of environmental aspects helps to solve environmental problems of steel smelting companies by realizing the environmental strategy. A strategy is a consistent concept of action, the implementation of which is to guarantee that fundamental long-term goals relating to a given area, e.g. environmental protection, are achieved. The planning document called "environmental strategy" refers to other internal documents and systems of companies, including an investment plan and waste logistic system.

Božena Gajdzik, Faculty of Science and Metallurgy, The Silesian University of Technology, Katowice, Poland

ENVIRONMENTAL ASPECTS

An environmental aspect is an element of an organisation's activities, its products or services that can interact with the environment, whereas a significant environmental aspect is one that has or might have a significant impact on the environment [1]. An impact on the environment, on the other hand, has been defined as 'any change to the environment, both positive and negative, that is caused fully or partly by an organisation's activities, products or services' [1].

According to the principles of environmental management a company should systematically carry out actions that enable it to identify environmental aspects, evaluate their impact on the environment, define the scope of the impact and use the information while setting its environmental strategy. Prior to the analysis of environmental aspects, they need to be identified and then presented in the form of the so-called environmental aspect table. The process comprises the following stages (below, the steel plant example):

1. Identify key activities in the company.
   Examples of activities (production methods) at steelworks:
   – ore agglomeration,
   – pig iron production,
   – converter plant,
   – electric steelworks,
   – continuous casting.
2. For all activities define the operations/tasks related to environmental aspects.
   Examples of operations for ore agglomerating plant:
   – unloading of sintering (agglomerating) materials,
   – storage of sintering (agglomerating) materials,
   – fly ash, ore and flux milling and the preparation of sinter mix,
   – sintering (agglomerating) the mix,
   – sinter (agglomerate) cooling and crushing,
   – sinter gas extraction,
   – transportation of the sinter (agglomerate) to the furnaces,
   – circulating water purification,
   – sludge storage and warehousing,
   – repairs (what kind of repairs?),
   – breakdowns (what type of breakdowns?).

Table 1. **An example of the environmental aspect table for ore agglomerating plant** [2]

Aspect	OA ums	OA ssm	OA sm	OA s mix	OA scc	OA sge etc.
Noise emission	x	x	x	x	x	x
Dust emission to the air	x		x			
Power consumption	x	x	x	x	x	x
Leakages to the soil		x				
CO emission				x	x	
NO_2 emission				x		
SO_2 emission				x		
CO_2 emission				x		
Emission of fluorine, aliphatic hydrocarbons, methane, hydrogen chloride and PCDD/F				x		
Natural resources use				x		
Waste production – iron-bearing sludge						x
Water consumption						
Waste water production etc.						

Table 2. **Inventory and estimation table of environmental aspects (points are exampled)** [2, 3]

No.	Environmental aspects	Points (significance) from 1 to 3	Scale of impact from 1 to 5	Multiply the significance by the impact
1.	Emission of CO_2	3	3	9
2.	Emission of SO_2	3	4	12
3.	Emission of CO	3	4	12
4.	Emission of NO_2	3	4	12
4.	Wastewater	1	4	4
5.	Sludge	2	1	2
6.	Noise emission	2	2	4
7.	Dust emission to the air	3	3	9
8.	Power consumption	2	2	4
9.	Leakages to the soil	2	3	6
10.	Emission of fluorine, aliphatic hydrocarbons, methane, hydrogen chloride and PCDD/F	2	3	6
11.	Waste production – iron-bearing sludge	2	3	6
12.	Water consumption	2	2	4
13.	Waste water production	2	3	6
14.	Effluent	3	4	12
etc.	Other contaminations			
Sum total				

3. Make a list of environmental aspects.
4. Assign symbols (abbreviations, marks) to particular operations.
   An example of symbols for steelworks:
   – operation: ore agglomeration (OA)
   – operations/activities:
   – unloading of sintering (agglomerating) materials (usm),
   – storage of sintering (agglomerating) materials (ssm),
   – fly ash, ore and flux milling and the preparation of sinter mix (sm),
   – sintering (agglomerating) the mix (smix),
   – sinter (agglomerate) cooling and crushing (scc),
   – sinter gas extraction (sge),
   – transportation of the sinter (agglomerate) to the furnaces (tsf)
   – circulating water purification (cwp),
   – sludge storage and warehousing (ssw).
5. Create the environmental aspect table, supplying "x" where applicable.

The identified aspects are evaluated in terms of quantity, by a certain value (amount), and quality, by the description of the aspect's significance for the achievement of the adopted environmental objectives.

Out of the whole set of identified aspects, a company selects the significant ones, which have to be controlled and monitored by the company (key aspects). The aspects that are most important for environmental protection are the key elements of environmental strategy.

ENVIRONMENTAL STRATEGY

The environmental strategy presents the manner in which a company is able to adapt for new demands of environment protection. The document indicates what the company ought to do to reduce the environmental nuisance. Its character is proactive and its realization does not only limit the quantity of wastes and pollution, but also prevents their production. The realization of environmental strategy brings the most desired effects when it is used for a long period of time, therefore it is necessary to realize it regularly and constantly. The implementation of the environmental strategy fundamentally influences the living conditions of present and future generations. It is a continuous aspiration to improve the quality of the natural environment - think globally, act locally [4]. The environmental protection strategies appeared in the late first half of the 20th century along with the development of the ecology awareness of societies and organizations. The strategies were progressing through the strategy of dilution, filtration, neutralization of the wastes, recirculation until the strategy of waste minimization and the strategy of Cleaner Production (CP) appeared. The last one is considered to be the model strategy. Today the environmental protection strategies are called environmental strategies. Strategies changed with time along with the change in environment protection models i.e. from passive (static) to active (dynamic) models with the Cleaner Production being an example of the latter. Strategies based on the static model did not bring about any significant improvements in the quality of the environment. Models such as the model of controlled drops, and the model of purification barely removed waste at the end of the pipe. Nowadays companies use the dynamic model. This model underlines the fact that the environmental changes depend on time. Modern strategies are based on the skills of foreseeing them and on prevention of negative effects. The best strategy is the Cleaner Production Strategy. The idea is based on waste source reduction in a concrete production process (manufacture). The prevention of waste production is connected with limiting the use of energy; therefore it has a specific economic reflection. According to the UNEP, the CP definition emphasizes that the strategy is active, constant and preventive, and it is also a set of activities integrated into the environmental protection domain. It consists of products, services and processes. Using it companies realize technological investments (BAT). The Cleaner Production Strategy is directed at eco – efficiency of production processes and eco - products, such as search and implementation of new wasteless or quasi-wasteless technologies, production of closed production cycles, creation of products that are environment friendly, utilization of wastes as secondary source materials. Its realization lessens the risk of environmental pollution and has a positive influence on people's health condition and the quality of the environment. Moreover, the modern strategies develop a responsible enterprise (win - win project management). A businessman foresees the environmental effects of actions and minimizes or eliminates negative actions for the environment [4].

The waste minimization programme is an element of the Cleaner Production Strategy. Minimization of the solid waste in Polish steel industry is realized by recycling. The recycling enables the companies to use waste (secondary materials) to the same productive process or similar one, or even totally different industrial branches, for example in construction industry. The companies use some active tools to reduce the wastes which are the result of production process. So we can say that they realize the waste minimization strategy. This strategy is an antidote to the Cleaner Production Strategy [4]. Nowadays we cannot talk about the Clean Strategy in steel industry because the pollutants and waste are still created in production processes. Figure 1 shows an example of environmental strategies classification.

WASTE LOGISTIC SYSTEM

In recent decades in Polish steel industry physically destroyed were more than 40% obsolete and environmentally noxious crude steel capacities. Processes be-

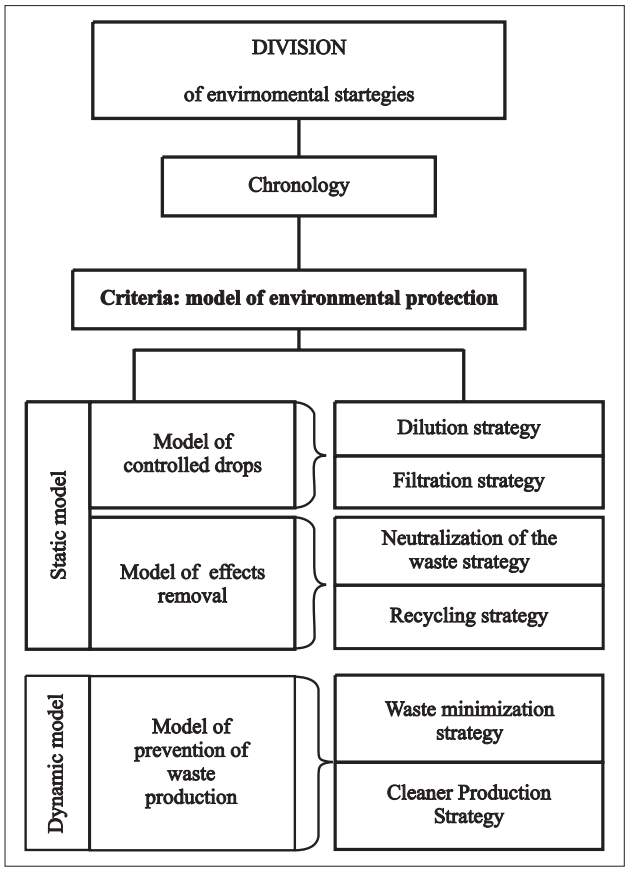

Figure 1. Division of environmental strategies [4].

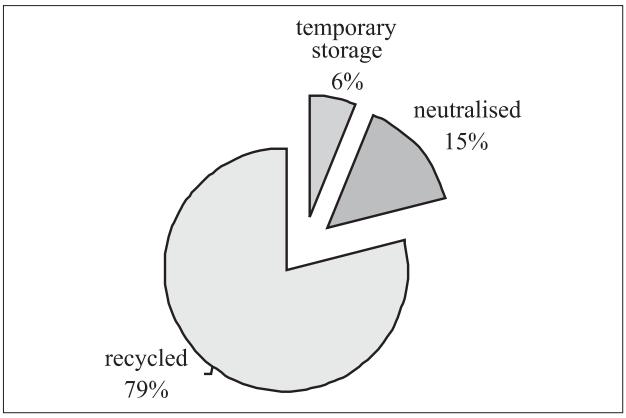

Figure 2. Solid waste management at steel making sities [5].

came less energy and material intensive. Main air emission –NO_x,SO_2 and dust –got reduced. In 2006 dust emission index was 0,7 kgs/mt crude steel average. Percentage index of dust caught in dedusting systems was at 98,8%. Iron and steel enterprises operate closed-circuit water systems. About 98% effluent discharged by steel manufacturing sites are treated. About 80% solid waste is recycled while the remaining portion is neutralized and/or temporarily storage (figure 2.) [5].

In metallurgy, the by-product of thermal ironmaking and steelmaking processes include blast furnace slags, steel slags and ferroalloy slags. In Poland specialist companies have opened that handle slag processing. They process the slag stored in slag dumps near steelworks and the slag supplied directly by steelworks. These companies produce aggregates from slag. The aggregate classification has been shown in table 3.

Table 3. **Aggregate classification** [6]

Aggregate type	Description
Blast furnace slag-based aggregate	The blast furnace slag's general properties are similar to those of natural rock materials. Aggregate grains are porous. They have a wide surface with sharp edges. Their important characteristic is a high friction factor and load capacity higher than that of natural materials. This type of aggregate has thermoinsulation properties and is freezeproof.
Steel slag-based aggregate	Steel slag is a by-product of the steelmaking process. Is is made from hardened lava, then crushed and finally iron is separated. Grains are also sorted. Steel slag-based aggregate has a high crushing strength (similar to that of magmatic rock, granite, basalt). The other characteristics of the aggregate are: rough surface, low absorbability.
Ferroalloy slag-based aggregate	This type of slag is created in the production of components for quality enhancement of steel. These slags have a great crushing strength and are highly freezeproof.

Table 4. **Use of aggregates in construction and highway engineering**

Industry	Examples of use
General construction	– pure blast furnace aggregate is used in the production of concrete slag blocks, – as hydraulic addition to cement, – as an addition increasing the durability of concrete.
Highway engineering	– in road foundations, – in road and highway construction, – in the production of asphalt surfaces, – in the construction of car parks, squares, pavements - so-called sub-crust that is placed under sett stones, – in the process of levelling out the land to be used for hypermarkets and other service and commercial facilities, – as sub-crust during pipeline installations (gas, water, sewage, drainage), – foundation (subsoil) strengthening.

Aggregates are used in the contruction industry, in general construction and highway engineering. They are added to building materials such as cement, for instance, but first and foremost they are used in the production of asphalt surfaces and road foundations and road wedging (table 4).

SUMMARY

The article presents selected aspects of environmental management in Polish metallurgical companies. Special attention is given, among others, to the following issues:

– identification and evaluation of environmental aspects that are caused by companies' negative impact on the environment,
– adjustment of the strategy to the implemented environment protection principles, according to the current model,
– waste management illustrated by the example of blast furnace, steel and ferroalloy slags.

LITERATURE

[1] Standard EN PN ISO 14001:2004 Environmental management system – requirements and guidelines.
[2] Gajdzik B.: Identyfikacja znacz'cych aspektów œrodowiskowych dla przedsiêbiorstw produkcyjnych sektora hutniczego, Hutnik-Wiadomoœci Hutnicze (2006)10, 463
[3] Gajdzik B.: Environmental management in a steel smelting company and environmental aspects. Annals of F.E.H. Journal of Engineering (in print).
[4] Gajdzik B., Wyciœlik A. Environmental strategies as the system of action – chronological order and market classification ANNALS of F.E.H. - JOURNAL OF ENGINEERING, (2007)3, 10-15
[5] Polish Steel Industry , Report 2007, HIPH, pp.17-21.
[6] Bendkowski J. Wengierek M: Logistyka odpadów part II, The Silesian University of Technology, Gliwice 2004, p.147, p.155.

Note: The responsible translator in Niuans Translation Agency – Gliwice, Poland.