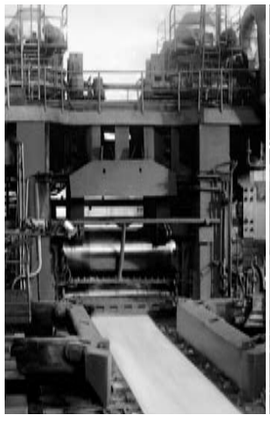
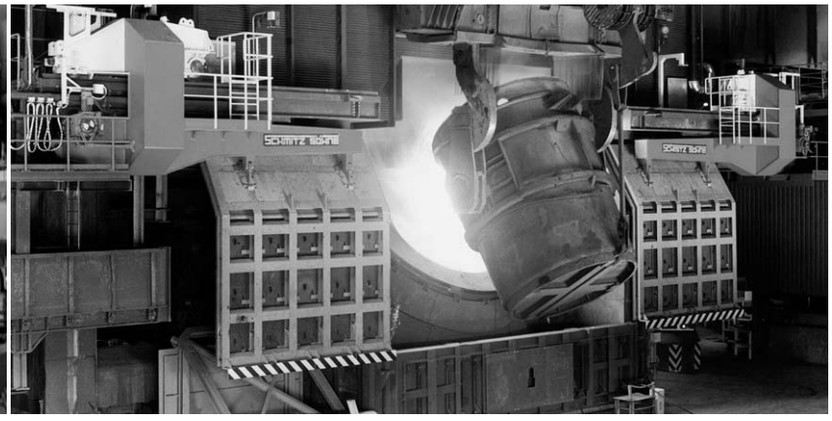


The Coking Plant of Czestochowa Steelworks, Poland

1 Steel Industry in Poland

Steel Production in Silesia, Southern Poland

Silesia in southwest Poland is the heartland of Polish industrialism. Sine the 19th century, its rich finds of black coal with domestic and imported iron ore has been the basis of a large Polish and iron and steel production, expanding even more during communist years.

The industrial production was, however, causing considerable pollution. The Silesian region was at the time of the systems change, 1989, considered an environmental disaster area, reflected in, e,g, a drastically lower life expectancy and larger incidence of especially respiratory diseases, than the rest of Poland. Emissions from the mines and the coal power plants were the main causes. Most industries then used outdated technologies and had been unable to replace worn out equipment.

At the systems change new environmental policies were adopted in Poland. A few factories were closed immediately. Among the continuing industries a list of the 80 worst polluters was established ("the list of 80"), most of them in Silesia. Work started to improve these facilities. Czestochowa Steelworks was among these.

The Czestochowa Steelworks *(Huta Stali Czestochowa)* is together with Nowa Huta in Krakow, among the largest steel industries in Poland. The Czestochowa Steelworks specializes in steel sheets and produces today over 65% of steel sheets manufactured in Poland, which is a total of 1 Mln tonnes per year, used e.g.in ship building. Additionally, the Steelworks produces semi-products like blooms used mainly in pipes and tubes production, as well as metallurgic and fuel coke.

The Technology of Iron and Steel Production

Iron and steel are made by reducing iron ore with carbon. Iron ore is mixed and heated with coal in key proportions in the hut (*huta* in Polish). Carbon is added in the form of coke to produce wrought iron with 3-4% carbon content. Steel is produced when the carbon content in the iron is reduced with oxygen (air) in the further process.

Coke is thus a basic component in iron and steel production. Coke is formed as black coal is dry-heated up to 1300 °C in the process of pyrolysis. In the process up to a third of the components of the black coal are evaporated as gases or forming tar. The solid remain, the coke, consists of up to 95% of pure carbon. The coke is a porous light weight material forming large agglomerates. They are mechanically divided into smaller more manageable pieces. The process of coke production is made in a *coke works*, or coking plant.

The gases collected during coke production are mostly hydrogen, but also considerable amounts of hydrocarbons. Most of them are aliphatic e.g. methane, ethane, propane and butane. All of these are valuable energy carriers and either used for the energy needs of the production (as in Czestochowa Steelworks) or fed into the gas net of the city. At the same time

Box 2.1 Czestochowa Steelworks Coking Plant

Currently the Coking Plant has two coking batteries of stamping system of PWR 51B type. The total amount of chambers is 114 (2x57). The annual production capacity of the Coking Plant equals to 550,000-600,000 tonnes of coke, which corresponds to about 1,500-1,600 tonnes of coke per day, with an annual carbon mixture consumption of about 800,000 tonnes.

The main products of the Coking Plant include: coke (stabilized, blast-furnace, industrial-combustible, and small size-nut, peanut, quick coke), coke gas and raw coke tar.

Moreover, benzene, sodium phenolate, ammonium sulphate and sulphur are produced.

they are slightly toxic and also green house gases, considerably more potent than carbon dioxide. Another group of hydrocarbons produced are the aromatic ones, e.g. benzene, and poly-aromatic hydrocarbons, PAH. These are toxic and cancerogenic. The same can be said of the tar that is formed during coke production.

Coke production may also use considerable mounts of water. Water is added to the coke to make it more porous and easier to work out later in the process. Most of the water leaves through the chimney as vapour together with various gases. This may also be an environmental concern.

Coke Production

Czestochowa Steelworks has two main production lines for coal products. The Coke Production Section consists of the Bunker, the Fire-basket, and the Sorting Plant. The second, the Carbon Derivatives Production Department, produces chemicals, in particular the gases mentioned above.

The Coking Plant with four coking batteries was built in 1958-1962. It was expanded in 1972-1973 with two more coking batteries. The overall production capacity was then at a maximum of 2.14 Mln tonnes of coke per year.

Emissions and Environmental Concerns

The environmental impact of steel production includes the production of considerable amounts of slag, emissions to the air, and water effluents. The air impurities are the most severe, including aromatic hydrocarbons, aliphatic hydrocarbons, acidifying oxides, especially sulphur and nitrogen oxides, and carbon monoxide. These are mainly caused by coke production.

Thus the Czestochowa Steelworks in 1996 as a whole gave rise to about 200,000 tonnes of slag, ash and rubble as solid waste. Of this almost all was caused by the steel production. Emission to the air amounted to 650 tonnes of gases and particles (see Table 2.1). Almost all of this came from the coking plant. The company payed a total of 1,343,000 PLN (~335,750 Euro) in environmental charges.

Work to reduce the negative environmental impact of the coke production began already in 1985. During 1989-1991 three of the six coking batteries were closed and the remaining three were modernized and renovated. Later on, one more battery was closed, and from the mid 1990s only two are in operation. The annual capacity is 600,000 tonnes of coke, or about 1.5 to 1.6 thousand tonnes per day, that is a third of the peak capacity. About 800,000 tonnes of black coal are used in the production (2004).

2 Introducing and Certifying an EMS in the Czestochowa Steelworks Coking Plant

The Environmental Management Systems and Certification

In mid 1990s systematic work to implement an environmental management system became a priority in the company. The first certificate according to ISO 14001 was received in 1997. The Coking Plant of Czestochowa Steelworks was the second company in Poland and the second coking plant in Europe to implement a certified environmental management system according to the ISO 14001 norm. The certificates were granted by the Polish Centre for Testing and Certification (PCBC) and Bureau Veritas Quality International (BVQI) and in the year 2000 by BVQI and Polish Register of Shipping (PRS)- certification associations.

Table 2.1 *Emission to the air from Czestochowa Steelworks in 1996 (tonnes/year). Almost all of this came from the coking plant.*

Ash	SO_2	NO_2	Benzene	Aliphatic hydro-carbons	Aromatic hydro-carbons	Benzo(a)-Pyrene	CO
107	58	367	7	104	6	0.016	49

After re-audit in 2000, the company decided to work to develop an integrated management system, IMS, which finally resulted in a new certification in 2005. The integrated management system includes the environmental quality management according to ISO 9000:2000 requirements, environmental management system according to ISO 14001:1996 requirements and industrial safety management system according to PN-N (OHSAS) 18001:1999 requirements.

The company has received a number of awards recognising its good environmental work, including the Gold Medals at the 1992 World Exhibition of Innovation, Research and New Technology "Eureka" in Brussels for the modernization of the coking battery, and the prize of "Pantheon of Polish Ecology" for the introduction of the EMS.

The Environmental Management System

The EMS was used both to establish and maintain the environmental profile of the company and to safeguard that legal requirements in the area were implemented. It was used to assure a continuous improvement of environment-oriented activities.

The directives of the Coking Plant Manager became the basis for launching work on the environmental management system. The head of the department issued a statement on the action of preparing and implementing environmental management system in the department.

In early 1996 an initial investigation of the Coking Plant was performed and training of the staff within the field of environmental management system and environmental protection was launched. The whole staff of the Coking Plant was familiarized with the environmental management system, its ideas and goals, and the employees, whose job might have an influence on the environment, were additionally trained.

Firstly, the EMS was prepared according to the British Norm BS 7750:1994. Soon, however, the decision was made to change the standard to the ISO 14001 norm. The internal auditing programme started in September 1996. In March 1997 BVQI performed an initial audit to prepare the Coking Plant for the certification process. The certifying audit was performed in May 1997 and the certificate issued in June 1997. The system was then in operation up to 2003, with a re-audit in 2000.

Table 2.2 *List of the significant aspects, 1997.*

No	Aspect	Source	Significant
1	Carbon ash emission	Coal-milling Plant I – system I	yes
2	Carbon ash emission	Coal-milling Plant I – system II	yes
3	Carbon ash emission	Coal-milling Plant II – system I	yes
4	Carbon ash emission	Coal-milling Plant II – system II	yes
5	Waste production – carbon ash	Coal-milling Plant	yes
6	SO_2 emission	Coking battery No 2 (battery trailing)	yes
7	NO_x emission		yes
8	CO emission		yes
9	Ash emission		yes
10	Aromatic hydrocarbons emission		yes
11	Aliphatic hydrocarbons emission		yes
12	CS_2 emission		yes
13	NH_3 emission		yes
14	Benzene emission		yes
15	Benzo(a)pyrene emission		yes
16	Hydrogen cyanide emission		yes
17	Phenol emission		yes
18	Pyridine emission		yes
19	Emission		yes
...			
...			
159	Aromatic hydrocarbons emission	Warehouse containers	yes
160	NH_3 emission		yes
162	Benzene emission		yes
163	Hydrogen cyanide emission		yes
164	Phenol emission		yes

Rationality of the EMS

The implementation of an EMS was seen as a rational continuation of the technical investments done. It has much lower costs than investment in further new equipment or technology, and it is at the same time an organizing tool, which serves to improve the ecological awareness of the staff and decrease the negative impact on the environment. It is an investment in the organisation and the people, being one of the most effective ways of investing.

A new organisation has been established, reference and responsibilities of the people involved in management of the company detailed. A new post as Specialist in Ecological Sys-

tems was created. This organisation safeguarded a proper information flow, the control of the function of people, the technical and measurement devices, and the documentation of all data and information. It also supported the required actions.

Environmental Policy

The starting point for environmental management, according to the requirements specified by the norm of the EMS, is the establishment of an environmental policy. From the policy environmental goals are derived, after recognition of the environmental impact of the company. Goals are accomplished through actions, which limit the harmful impact of production processes on the environment. This requires that management appoint people responsible for accomplishment of these tasks within a certain timeframe and provide proper technical and financial tools. In other words, it amounts to the establishment of an environmental protection programme.

3 Environmental Work

Identifying Environmental Problems (Aspects)

The environmental work started with the identification and evaluation of potential environmental threats, so-called, aspects (see Table 2.3). When this work started we went into detail in the process of the Coking Plant. Looking into the uncontrolled emissions from the coking batteries (so-called battery-trailing) we specified a dozen aspects (e.g. carbon monoxide, aromatic hydrocarbons, aliphatic hydrocarbons, benzene, ammonia, hydrogen sulphide, phenol and other emissions). In practice it was not meaningful to divide the emission into its components, and in the next round of the identification process, emissions was considered to be one aspect. There were more such examples. Some aspects were not identified at all, which was revealed during the audit.

Establishment of criteria how to evaluate the aspects became an even bigger problem. A first criterion was the legal

Table 2.3 *List of significant aspects, 2002.*

No	Activity/product	Aspect	Status
1	Coal-milling plants	Carbon ash emission from coal-milling plant 1 and 2	S
		Waste – carbon ash precipitated in dust collectors	S
2	Coke sorting plants	Coke ash emission – W1, W2, W3, W4, W5	S
		Waste – carbon ash precipitated in dust collectors	S
3	Battery trailing (filling-in, coking, pushing-out)	Ash emission from the process of coking chambers stuffing	S
		Waste – carbon ash precipitated in dust collectors	S
		Raw coke gas emission during break-down	S
4	Coke battery firing	Dust-gas emission from batteries 2 and 4	S
5	Coke extinction	Dust-gas emission	S
		Increased dust-gas emission connected with coke tower activity at the time of break-down	S
6	Carbon derivatives (condensation, ammonia plant, benzol plant, desulfurization plant, tar and benzol store, dephenolization plant, mechanical treatment plant)	Waste production: quick coke	S
		Waste production: saturator black blende	S
		Waste production: total salts	S
		Waste production: waste sulphur	S
		Sewage discharge to sanitary sewer system during break-down	S
		Sewage discharge to storm water-industrial sewer system during break-down	S
		Increased gaseous pollutants emission in the process of coke gas purification at the time of break-down	S
7	Administrative and production activities of the Coking Plant	Waste production: left after repairs	S
		Waste production: hazardous (fluorescent lamps, batteries, waste oils)	S

limits. However, then it was hard to accept e.g. emission of coal ash from the Coal-milling Plant as a significant aspect, as the allowable emission value was 1 kg/h, and the measured emission was 0.1 kg/h; in the same way for the emissions of coke ash from the Sorting Plant, the allowable emission values was 2 kg/h, and the measured value was 0.1-0.2 kg/h level.

Other criteria involved the Environmental Policy and costs connected with an emission or aspect. When performing the evaluation according to these criteria over 150 significant aspects were identified.

However, since it became difficult to supervise so many items in a proper way, it was necessary to change the criteria. It was thus decided that emissions were to be significant aspects, if its value will exceed 50% of the value specified by the norm. Later on other criteria were also changed. The change in the definition of criteria reduced the number of significant aspects in the Coking Plant to 19. Table 2.2 shows examples of significant aspects from the 1997 list, and Table 2.3 shows a full list from 2002.

Environmental Goals

After identification and evaluation of environmental aspects, it was possible to get down to evaluation of the "Environmental Management Programme". However, in order to evaluate a programme, it is necessary to already in advance establish which goals we want to achieve.

The Coking Plant used an algorithm for environmental goals identification. Based on this the tasks and undertakings were established. As these are achieved the environmental goals are accomplished. Realization of the "Environmental Management Programme" allows the plant to develop in accordance with its environmental policy and legal requirements and constantly improve its impact on the environment.

Table 2.4 presents an example of environmental goal establishment regarding waste water. Table 2.5 shows how tasks and undertakings are identified to reach the goal.

Figure 2.1 Converter. *Steel is melted from such raw materials as pig iron, scrap and alloy additions. Photo: Stahl-Zentrum.*

Table 2.4 *Development of environmental goals regarding waste water from the coking plant.*

Significant aspect	Source	Exceeded law limit?	Incompatibility with politics?	Signals from interested parties?	Necessity for improvement?	Goal
Wastewater discharge	Wastewater treatment plant	No	No	Yes	Yes	Decrease cyanides content in wastewater

Training of Staff

Establishment and implementation of an EMS requires training and education of the employees and the whole staff to increase the environmental awareness and prepare them for the new responsibilities within the EMS implementation. The training was performed to inform the employees about:

- The meaning of acting in accordance with environmental policy and procedures as well as requirements of the environmental management system.
- Significant, current or potential impact of a workers' performance on the environment, as well as environmental benefits resulting from the improvement of their performance.
- Their tasks and responsibilities in achieving in accordance of performance with environmental policy and procedures as well as requirements of the environmental management system, together with the requirements related to readiness in case of break-downs and responding to them.
- Potential consequences of disobedience of the set operational procedures.

A detailed process was developed to identify the training needs based on linking significant environmental aspects with a corresponding post job. Next a list of posts, on which work might exert a significant influence on the environment (so-called key staff) was selected. Those key staff were given an additional, so-called detailed, training.

Training materials set for the key staff within a department, include all the information necessary for the work done on the posts in a way that assures meeting the environmental policy requirements of the department as well as the legal requirements connected with EMS, and documents for operational piloting. They were divided into four parts (see Box 2.2).

Apart from the training programme for management of the department, training for engineering-technical staff was performed. For these, the training materials were prepared in the form of a booklet including the following set of information. (1) the impact of the Coking Plant on the environment, (2) future planned changes, (3) costs connected with environmental protection, (4) information on the environmental management system and components of the system according to ISO 14001, (5) ways of implementing EMS in the plant, (6) benefits resulting from implementation of the system in the light of environmental impact.

Documents

The initial training included the whole crew of the Coking Plant. There was a special information pamphlet prepared for them, which contained short information on their responsibilities resulting from the implementation of environmental management system, department policy, significant environmental aspects, and environmental protection regulations.

Having a well-trained crew and precise identification of environmental aspects and their evaluation, it was necessary to set the range of activities of the plant, needed to be put under a detailed operational supervision. Therefore, we drew up systems documents (procedures, instructions, specifications etc.), in which operational criteria were defined. Proper monitoring

Table 2.5 *Environmental Management Programme (4 PLN~ 1 Euro).*

No	Task/subject	Deadline	Person responsible, Executor	Plan type, in which the task was included	Expected costs [PLN]	Effects
1	Testing new technology of after-generation water treatment of cyanides.	31.12. 1999	Head of the Carbon Derivatives Department/Head of the of Environmental Protection Laboratory	Included in investment costs	5,000	40% decrease in the amount of cyanides present in after-generation water by 31.12.2000 with respect to the 2nd half of 1998.
2	Construction of new installation for after-generation water treatment of cyanides.	31.06. 2000	Vice Head of the Coking Plant Department/Main power engineer	Included in investment costs	10,000	
3	Implementation of new technology for after-generation water treatment of cyanides.	31.12. 2000	Head of the Carbon Derivatives Department/Head of the Environmental Protection Laboratory	Included in investment costs	5,000	

Box 2.2 Content of the training for staff responsible for environmental management

Part I.

The environmental management system according to ISO 14001

1. Historical draft of the environmental management system
2. Description of the ISO 14001 norm
3. Overall definitions
4. Elaboration and implementation stages of EMS
5. Methodology of performing an initial inspection of the plant (wpw)
6. Documentation of the system
7. Organisational changes
8. EMS audits
9. EMS inspection by the management of the plant
10. Certification
11. Expected effects of the running EMS

Part II.

Environmental protection, the impact of the Czestochowa steelworks and coking plant on the environment

1. General information
2. Information on the plant
   - 2.1. Ecological investments in the Steelworks in the past 10 years
   - 2.2. Values characterizing the impact of the Steelworks on the environment
   - 2.3. Perspective for further planned changes with relation to ecological requirements
3. Coking Plant Department
   - 3.1. Initial information
   - 3.2. Type of pollution emitted by the Coking Plant
   - 3.3. Existing devices and installation of the Coking Plant eliminating environmental pollution
   - 3.4. Atmospheric emissions
   - 3.5. Noise
   - 3.6. Water and wastewater
   - 3.7. Soil and groundwater contamination
   - 3.8. Current way of acting in the case of a breakdown
   - 3.9. Waste
   - 3.10. Technological-production information
     - *3.10.1. Raw products*
     - *3.10.2. Products*
     - *3.10.3. Energy*
   - 3.11. Utilization of raw materials for production and as energy carriers
   - 3.12. Analysis of the impact of the Coking Plant Department on the environment
   - 3.13. Costs spent on environmental protection by the Coking Plant in 1996
4. Register of law annotations connected with environmental protection
   - 4.1. Overall part
   - 4.2. Water – overall part
   - 4.3. Air protection
   - 4.4. Wastewater
   - 4.5. Waste
   - 4.6. Decisions
   - 4.7. Internal regulations
   - 4.8. Allowable levels of pollutants in wastewater

Part III.

Environmental management system in the coking plant department

1. Introduction
2. Statement of the Head of the Coking Plant Department
3. Environmental Policy of the Coking Plant Department
4. Relations with Czestochowa Steelworks
5. The range of responsibility
6. Information transfer
7. EMS documents checklist
8. Typical irregularities causing ecological threats

Part IV.

Description of the coking plant departments

1. Carbon-sorting Plant
   - 1.1 Characteristic of equipment in the Carbon-sorting Plant
   - 1.2 Characteristic of emitters and dust collectors in the Carbon-sorting Plant
   - 1.3 Register of significant aspects of the Carbon-sorting Plant
2. Fire-basket Plant
   - 2.1 Description of the equipment in the Fire-basket Plant
   - 2.2 Characteristics of emitters and dust collectors in the Fire-basket Plant
   - 2.3 Register of significant aspects of the Fire-basket Plant
3. Carbon derivatives
4. Hazardous and flammable materials

of these areas and sticking to set operational criteria allowed a supervision over significant environmental aspects and at the same time decreases harmful environmental impact of the plant. Table 2.6 shows a list of a few procedures and instructions serving as an operational supervision tool.

4 Results of the EMS

Results of the Implemented Changes

Tables 2.7 and 2.8 show the effects of the "pro-ecological" changes in the Coking Plant between 1996 and 2004. The charges for emissions decreased to almost a quarter (see Table 2.7). The emissions (see Table 2.8) are all deceasing with the exception of carbon monoxide. The "increase" in carbon monoxide emission results from employing new measurement methods – analysers instead of gas volumetric analysis with an Orsat apparatus (after J. Kapala)

The costs of the implementation of the environmental management system did not exceed 250,000 PLN (~62,500 Euro). The value includes working time of the staff employed at the time of implementation, training costs, and the inspection carried out by the consulting and certification company. In the previous period significant costs were borne due to technical and technological modernization. They are however not directly linked to the costs of the implementation of the system.

The issuing of the environmental management system certificate was certainly one of the most important points. As a result the Coking Plant was taken off the list of companies having the most harmful impact on the environment (so-called "80 list").

Many of the benefits resulting from implementation of the environmental management system cannot be assessed in terms of financial benefits. It involves improvement of ecological awareness of the staff, arrangement of the activities connected with environmental protection, improvement of how the department is evaluated by others, and so on.

In addition it should be mentioned that the coking plant emitted 89,165 tonnes of carbon dioxide in 2004, which was less than half of the 199,670 tonnes emitted from the Steel works as a whole.

The charges caused by emissions were a total of 654,631 PLN (~163,658 Euro). Of this 368,509 PLN (~92,127 Euro) or almost half, was caused by the coking plant. The solid waste from steel production was 1,111 tonnes.

Table 2.6 *List of documents used in the environmental management system illustrated by some procedures and operational instructions.*

Identification number	Title of the document
PC 6.1/10	Waste handling procedure in the Coking Plant
PC 6.1/11	Energy management procedure in the Coking Plant
PC 6.2/1	A procedure of controlling, monitoring and process measurement that might have a significant influence on the environment
PC 6.5/1	Identification and evaluation of potential break-down events; prevention of break-downs and acting at the time and after a break-down in the Coking Plant
ICS 0001	Seasonal waste handling manual
ICS 0101	Ash from dust collectors from Coal and Sorting Plants handling manual
ICS 0201	Coke ash from Dust Extraction Plant handling manual
ICS 0301	Total salts handling manual
ICR 0108	Dust extraction of the Coal-milling Plant handling manual
ICR 0123	Dust collection installation of the Sorting Plant operation manual

Cost

The argument often used against implementation of an environmental management system is high cost. However it is not as high as often suspected. The basic cost is the amount of time spent on the establishment and implementation of the system. For a group composed of a few hundreds of people, the full-time work done by one or two people is enough, and from several to a dozen percent of time spent by a group composed of ten up to fifteen people. It is worth making a comparison between these costs and total environmental protection costs in a company, including not only charges and fines, but also investments, repairs and running environmental protection devices, waste and by-products processing costs, energy loss (it is also a waste due to, e.g. carbon dioxide) and others.

The costs for the implementation of an EMS have to be considered as insignificant in comparison with all technical investments. The issue of costs and effects resulting from the implementation of the environmental management system deserves to be handled separately and in more detail.

The above mentioned difficulties should not become an obstacle for effective implementation of the management system. Nonetheless, it is better to be aware of them and prepare oneself properly for them rather than to allow them to appear step by step in the cause of work. The establishment and implementation of the system has to be based on a serious and considerate attitude of the company to this matter.

Figure 2.2 Steel heavy plates. *Technical solutions used in the rolling mill enable manufacturing of many categories of steel plates with various properties and applications. Photo: Stahl-Zentrum.*

Table 2.7 *Environmental fees charged to the Czestochowa Coking Plant in the years 1996-2004 (4 PLN~1 Euro).*

Year	Charge [PLN]
1996	1 342 943
1997	560 000
2001	303 436
2002	283 233
2003	368 223
2004	368 509

Table 2.8 *Emission of pollutants to the atmosphere from the Czestochowa Coking plant in the years 1996-2004.*

	Emission (tonnes/year)							
Year	ash	SO_2	NO_2	Benzene	Aliphatic hydrocarbons	Aromatic hydrocarbons	Benzo(a) Pyrene	CO
1996	107	58	367	7	104	6	0.016	49
1997	72	38	312	2	62	5	0.010	249
2001	72	33	465	1.2	39	3.0	0.006	311
2002	67	42	380	1.2	40	2.4	0.005	261
2003	100	42	435	1.9	59	4.1	0.009	313
2004	90.5	43.6	406	1.8	56	5.6	0.009	455

Recommendations

The EMS in the Coking Plant Department was implemented in a very good fashion. The management of the department was deeply involved and the employees had a rather high environmental awareness.

The advantages of the EMS begin to become more and more visible, especially for the Coking Plant staff. The staff training programme resulted in increased environmental awareness, attention paid to the quality of the work, and its influence (real and potential) on the environment. The procedures and systems established allow a better control both of production and management of the department. Communication is constantly being improved.

The key-point for successful implementation of an EMS is the support of the management of the company. Without the support of the management, the cooperation between workers are unlikely to occur. The management serves to ensure that the project meets the needs of the whole organisation, and not only a part of it.

It is worth summarising some experiences from our work on implementation of the system.

These are in short:

- *The management of the company should be responsible for the project*. It is then more likely that they take an active part. If the project is carried out by specialists, it is easier for the management to neglect the results of the work. When the management takes part in the establishment of the goals of the project, they are better linked to the real circumstances of the company.
- *It is necessary to follow the advice of the management for each stage*. Such a procedure protects the project from deformation, as well as increases the management openness for suggested solutions.

- *One should not allow technical aspects to become a dominating issue*. It is necessary to take into consideration less rational aspects of the problem of the project implementation. It mainly revolves around the influence of people on the suggested changes and solutions and how they affect people.
- *Collection and interpretation of all the data should be processed quickly and efficiently*. A long process of collecting data is not in favour of realizing the project. Quick and efficient collection of information will make the project implementation process shorter and increase its usefulness.
- *One has to be prepared for difficulties when implementing a new system*. If the management is able to foresee the problems and is preparing for them, they will, however, not have a negative impact on the effectiveness of the project. The management should cooperate with employees in the course of establishing ideas and suggestions.
- *It is essential to keep a register of all records connected with the implementation of the EMS*. They are the basis for making proper decisions and serve as an evidence for its proper function. As the project proceeds, assumptions and information initially incorporated might become obsolete. A record of previous measures made will then help in solving such problems in the future.

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Figure 2.3 The central laboratory. *Examining chemical composition of steel, refractory materials, ferroalloys, slag, alloys, steam and coking coal, effluents and potable water.*