BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 91

THEMATIC REPORT ON HELCOM PITF REGIONAL WORKSHOPS HELD IN POLAND

- STATUS OF THE POLISH JCP HOT SPOTS -

HELSINKI COMMISSION
Baltic Marine Environment Protection Commission
2003

For bibliographic purposes this document should be cited as:
HELCOM, 2003
Thematic Report on HELCOM PITF Regional Workshops held in Poland;
Status of the Polish JCP Hot Spots

Baltic Sea Environ. Proc. No. 91

ISSN 0357-2994

Thematic Report on
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Contents

Foreword 7

Summary 8

Introduction 10

Polish hot spots included in the JCP List 11

Map of Hot Spots in force located in Poland 12

HELCOM PITF Regional Workshops 13

HELCOM PITF Regional Workshops in Poland 13

Thematic Report on Polish Hot Spots –Terms of reference 15

System of fees and fines for the use of the environment 17

Legal framework of the system of fees and fines in Poland 17
Fees 18
Administrative cash fines 19
System of environmental protection funds 19
Integrated system of financing environmental protection in Poland 20

Financing the water protection investments by the National Fund for Environmental Protection and Water Management 21

Sources of financing investment projects in municipal sewage treatment plants – Analysis of availability of various sources and their use in the JCP Hot Spots in Poland 23

Structure of sources of financing water management and water protection investment projects in cities as compared with other parts of Poland 23
Availability of funds from external sources 24
Municipal investment projects in the light of European Union directives 26
Sources of financing investment projects in the process of integration with the EU 26
Costs of investment projects in municipal Hot Spots 26
Sources of financing investment projects in municipal Hot Spots 27
Investment project effectiveness 28
Conclusions 29

Analysis of wastewater treatment technologies at municipal Hot Spots…….…... 32

Municipal Hot Spots..... 39

Hot Spot No. 74 – Jamno WWTP / Koszalin..... 40
Hot Spots Nos. 82, 83.1, 84 – WWTPs / Warsaw..... 42
Hot Spot No. 85 – Hajdow WWTP / Lublin..... 46
Hot Spot No. 87.1 – Plaszow WWTP / Cracow..... 47
Hot Spot No. 87.2 – Kujawy WWTP / Cracow..... 49
Hot Spots Nos. 97.1, 97.2 – Pomorzany WWTP and Zdroje WWTP / Szczecin..... 51
Hot Spot No. 99.2 – Left River Bank WWTP / Poznan..... 53
Hot Spot No. 100 – Group WWTP / Lodz..... 54
Hot Spot No. 103 – Wroclaw WWTP..... 56
Hot Spots Nos. 88.1, 88.2, 88.3, 88.4 – WWTPs / Katowice Area..... 57

Industrial Hot Spots..... 62

Hot Spot No. 87.2 – Tadeusz Sendzimir Steel Plant / Cracow..... 64
Hot Spot No. 89 – Organika-Azot Chemical Plant / Jaworzno..... 69
Hot Spot No. 98.2 – Szczecin-Skolwin Paper Mill / Szczecin..... 76
Hot Spot No. 104 – Rokita Chemical Plant / Brzeg Dolny..... 78
Hot Spots Nos. 88.5, 88.6, 88.7, 88.8 – Industry / Katowice Area..... 82

Coastal Lagoons..... 85

Hot Spot No. 73 – Vistula Lagoon..... 86
Hot Spot No. 113 – Szczecinski Lagoon..... 90

Agricultural Hot Spots..... 94

Polish Hot Spots deleted from the JCP List..... 95

Hot Spot No. 75 – Debogorze WWTP / Gdynia..... 95
Hot Spot No. 76.1 – Wschod WWTP / Gdansk..... 95
Hot Spot No. 76.2 – Gdansk Refinery..... 96
Hot Spot No. 77 – Frantschach Swiecie Paper Plant / Swiecie..... 99
Hot Spot No. 78 – Fordon WWTP / Bydgoszcz..... 100
Hot Spot No. 79 – Kapusciska WWTP / Bydgoszcz..... 100
Hot Spot No. 80 – Torun WWTP..... 101
Hot Spot No. 81.1 – Anwil Nitric Plants / Wloclawek..... 101
Hot Spot No. 83.2 – Siekierki Heat & Power Plant / Warsaw..... 105
Hot Spot No. 90 – Boruta Dyestuffs Plant / Zgierz..... 112
Hot Spot No. 91 – Dwory Chemical Company / Oswiecim..... 112
Hot Spot No. 92 – Boleslaw Metallurgical & Mining Plant / Bukowno..... 113
Hot Spots Nos. 96, 111 – Salt control / Vistula and Odra upper basins..... 113
Hot Spot No. 98.1 – Police Chemical Plant / Police..... 113
Hot Spot No. 99 – Central WWTP / Poznan..... 121
Hot Spot No. 101 – Lacza WWTP / Zielona Gora..... 121
Hot Spot No. 102.1 – Prochowickie Poultry Processing Plant / Prochowice..... 123

Hot Spots No. 102.2, 102.3 – KGHM Polish Copper / Glogow, Legnica..... 126
Hot Spot No. 105 – Ubocz Fertilizer Plant / Gryfow Slaski..... 135
Hot Spot No. 106 – Wizow Chemical Plant / Boleslawiec..... 136

List of legal instruments relevant to the Hot Spots…..... 141

ATTACHMENT 1. Lists of Polish JCP Hot Spots in force and deleted..... 142

ATTACHMENT 2. Polish JCP Hot Spots – Timetable for deletion..... 146

Glossary of abbreviations and acronyms..... 157

List of Baltic Sea Environment Proceedings..... 161

The elaboration of this Report was ordered by the Polish Ministry of the Environment and financed by the Polish National Fund for Environmental Protection and Water Management.

FOREWORD

The main purpose of the elaboration of this Thematic Report is to present the situation with regard to the individual Polish Hot Spots

The initiative relates directly to the HELCOM PITF Regional Workshops arranged in the Baltic Sea countries and devoted to analysing the implementation of the third element "Investment Activities Addressing Point and Non-Point Source Pollution" of the Baltic Sea Joint Comprehensive Environmental Action Programme (JCP).

By the end of October 2002, ten Regional Workshops and one bilateral meeting had been conducted, covering all the countries participating in the JCP/PITF. Participants in the workshops included representatives from local, regional and national administrative levels and the so-called "Hot Spot owners".

The overall aim of the workshops was to present information and data on Hot Spots to provide an overview on the environmental situation in general and the status of Hot Spots in the countries/regions concerned as basis for a detailed discussion of individual Hot Spots with a view to their future deletion from the List of Hot Spots.

Two such Regional Workshops took place in Poland, one in Cracow (September 2001) and one in Wroclaw (October 2002). Conclusions drawn at the workshops are reflected in this Report.

This report has been realised according to an Agreement No. 545/02/WN50/ME-OW-TX/D between the Ministry of the Environment of Poland, and the "Glob" Company, and has been financed by the National Fund for Environmental Protection and Water Management. The report reflects the situation by the end of 2002.

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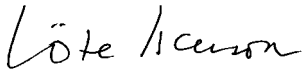
Helsinki, 28 May 2003



Göte Svenson
Chairman of HELCOM PITF
and Chairman of the Regional Workshops

SUMMARY

From the beginning of the JCP, 24 Polish Hot Spots and Sub-Hot Spots have been deleted from the List. At present, 18 Polish Hot Spots comprise 28 sources and locations and include 24 point sources, two diffuse sources and two coastal lagoons.

Two HELCOM PITF Regional Workshop arranged in Poland provided very good overview of situation in particular sites. It is expected that all Polish municipal and industrial Hot Spots could be deleted before the end of the JCP.

Most investments in Hot Spots originate from the enterprises themselves. The other significant sources are ecological funds and the domestic state and commercial banks. During the implementation of actions the foreign investment has been rather low so far. Marked progress and environmental protection results achieved in the last years confirm the effectiveness of the integrated system of financing environmental protection in Poland. Environmental protection funds and the Environmental Protection Bank which co-operates with them play the basic role in the system. The income generated by funds come from fees and fines.

Municipal Hot Spots

According to the negotiated transition periods the Directive 91/271 on treatment of municipal sewage will have to be implemented in Poland by the end of 2015. Deadlines for the implementation of the regulations very and depend on the size of a conurbation. It is estimated that the total cost of the provision of treatment plants in conurbations and the extension and modernisation of collective sewer systems will amount to more than EUR 9 billion.

Seven Polish wastewater treatment plants have been deleted so far (in years 2000 – 2002). Another eleven remain in the List, not taking into account four areas covered by the Hot Spot No. 88 – Katowice Area. Although investment activities have been started in each of them, various stages of development may be observed. Nevertheless, for ten Hot Spots the timetable for deletion, when all the requirements are met, may be set. It looks that there should be no Polish municipal Hot Spots in the List in 2010.

"Jamno" WWTP in Koszalin (Hot Spot No. 74) is considered as close to deletion. A date of 2009 is set for extension of "Czajka" WWTP in Warsaw (Hot Spot No. 82).

Industrial Hot Spots

HELCOM Recommendations constitute a milestone in the development programs for specific branches of industry. Their implementation is one of the key issues in the State Environmental Policy. Reduction of the use of natural resources, investments and modernisation, and in some cases reduction of production volumes or even total abandonment resulted in deletion of 15 industrial plants from Polish part of the Hot Spot List. Another eight remain in the List. The closest to deletion is Hot Spot No. 104, "Rokita" Chemical Plant in Brzeg Dolny. The environmental effect of the investment is

expected to be achieved in 2003. “Organika-Azot” Chemical Plant in Jaworzno (Hot Spot No. 99) seems to be the biggest problem. Contaminated land reclamation and safe liquidation of the old and unsafe hazardous waste dump sites are estimated to cost approximately EUR 25 million.

The national legal system of environment protection is considered to be complicated and strict. Still, the AOX and toxity monitoring in wastewater is not yet mandatory for industrial plants. This obligation is included in the executive order of the Environmental Protection Law, which will come into force in the near future.

Coastal Lagoons

There are two coastal lagoons in Poland listed as Hot Spots in the JCP List, both transboundary areas: Vistula Lagoon (Hot spot No. 73) and Szczecinski Lagoon (Hot Spot No. 113).

These specific Hot Spots are covered by Element 4 of the JCP which was formulated as management programmes for coastal lagoons and wetlands. The Integrated Coastal Zone Management Plans were elaborated for both lagoons under the PITF MLW project.

The major problem affecting the lagoons is the pollution load from the catchment area entering the reservoirs via rivers, resulting in the water eutrophication. Apart from eutrophication, another problem is complicated model of public administration composed of numerous elements and transboundary character of the areas.

INTRODUCTION

In September 1990, a Baltic Sea Conference was held in Ronneby, Sweden, at Prime Ministerial level. In addition to the Baltic Sea States, the Ronneby Conference welcomed the participation of Norway, the Czech Republic, the European Economic Community and four multi-lateral development banks. The Conference adopted the Baltic Sea Declaration, 1990, which called for elaboration and subsequent implementation of the Baltic Sea Joint Comprehensive Environmental Action Programme (JCP).

In April 1992, the Diplomatic Conference of Ministers of the Environment approved the JCP. For the JCP co-ordination the Program Implementation Task Force (PITF) was established.

The aim of the Programme is to present remedial measures to restore the Baltic Sea environment to ecological balance in realistic technical and financial terms. The Programme has a life-span of twenty years, 1993-2012.

After the Ronneby Conference, eight pre-feasibility studies were conducted in many different areas, including the Vistula River Basin and Odra River Basin. These studies examined point and non-point sources of pollution in the Baltic Sea catchment. They also served as a basis to help with the identification of "hot spots" of industrial, municipal and agricultural nature.

Element 3 of the JCP was formulated as investment activities addressing these point and non-point source pollution. The Hot Spots include traditional point sources of pollution associated with municipal and industrial source, non-point source pollution from agriculture and rural settlements as well as special management priority areas related to coastal lagoons and wetlands (co-operative development of management plans for key sites of international, regional and local significance).

One of the most important determinants in the process of hot spot identification was the matter of negative impact that a given site was exerting on the Baltic Sea. Cost-effectiveness of proposed remedial activities was another important factor. The overall idea was to focus on sites where the proposed investments would bring about the most rapid restoration of the ecological balance of the Baltic Sea environment.

Originally 132 Hot Spots were identified within the catchment area of the Baltic Sea. 47 were the priority sites where investments would result in significant reduction of the pollution load discharged into the Baltic Sea. Some of the Hot Spots are large municipal-industrial areas facing a number of environmental problems. Transboundary areas shared by two countries have also been introduced to the List.

To date, 54 Hot Spots and Sub-Hot Spots have been deleted from the Hot Spot List, as a result of investment activities and clean-up efforts.

POLISH HOT SPOTS INCLUDED IN THE JCP LIST

In the Polish part of the Baltic Sea catchment area most of all the Hot Spots, comparing to other countries, were originally covered by the JCP, that is 37 of a total of 132 locations, including three shared with the neighbouring countries. The actual number was even greater since some of them included two or more "sub-hot spots". The reason for such a great number of Polish Hot Spots is the specific situation of Poland in the Baltic Sea Region. 99.7 % of the Polish territory lies within the Baltic Sea catchment area, covering 311.900 km^2 and approximately 40 million inhabitants, while the total Baltic catchment area is more than 1,7 million km^2 and is inhabited by more than 80 million people. The hydrological configuration of the country is also very important since almost 90 % of the river outflow is carried by the Vistula and Odra rivers, and 10 Pomeranian rivers contribute the rest 10 %.

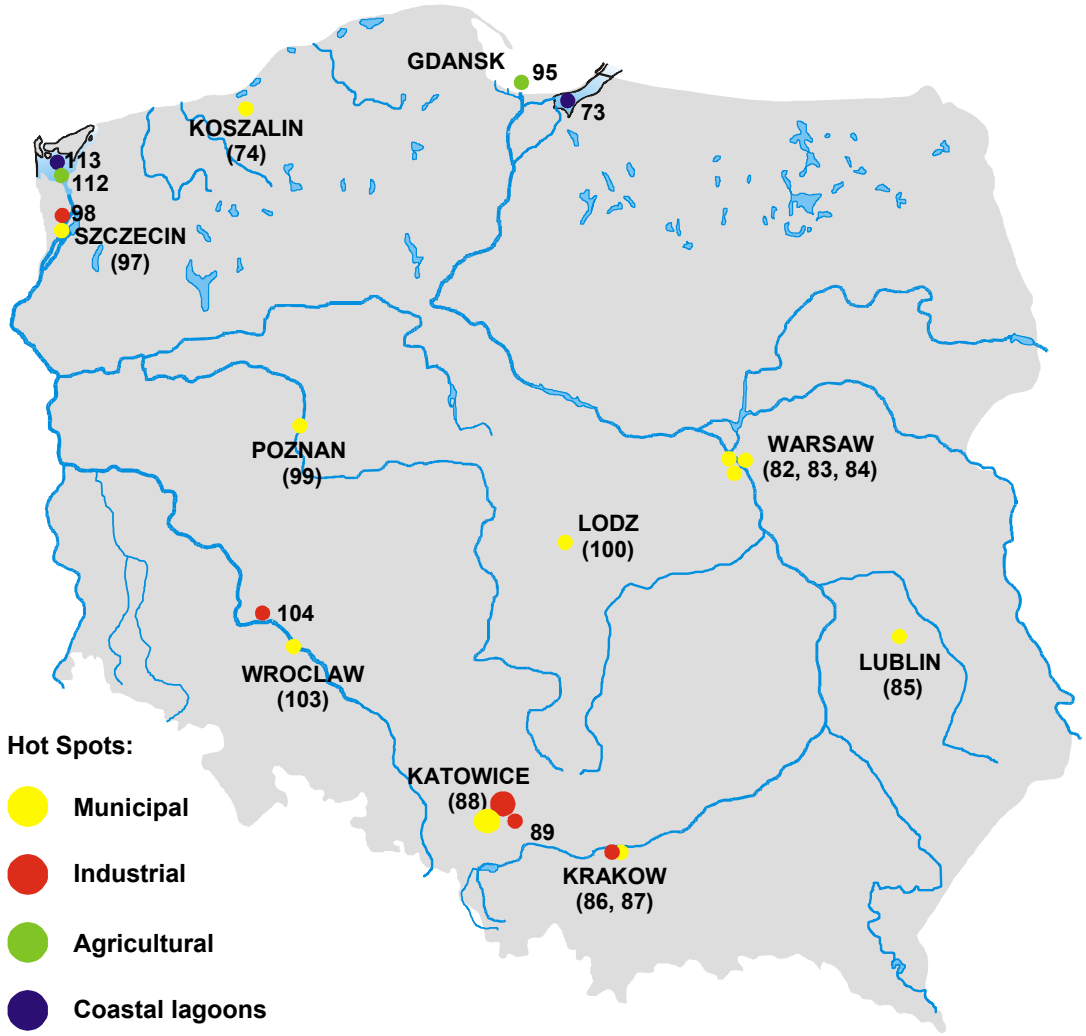
In 1999 Poland initiated the revision of the JCP List with regard to the Polish part. Some of the Hot Spots were proposed to be included, changed or deleted from the List. The rationale behind that proposal was the opinion that after so many years of rapid and far-reaching changes in the region, several locations did not qualify for being the hot spots and should be removed from the List and some of them have not qualified since the very beginning. At the same time some of the hot spots needed to be described more precisely in order to take care of them. The process of revision was finished in December 2001 and by the decision of the PITF changes proposed by Poland were introduced.

From the beginning of the JCP, 24 Polish locations have been deleted from the List, including seven wastewater treatment plants, 15 industrial plants and two hot spots described as discharge of saline mining waters.
At present, 18 Polish hot spots comprise 28 sources and locations and include:

- 24 point sources of pollution (8 industrial and 16 municipal);
- 2 diffuse sources (agricultural hot spots);
- 2 coastal lagoons.

The list of valid Polish hot spots as well as locations deleted from the JCP List is presented as Attachment 1.

Map of Hot Spots in force located in Poland



HELCOM PITF REGIONAL WORKSHOPS

In the light of recent developments in the Helsinki Commission the Program Implementation Task Force has undertaken activities aiming at reconsidering its priorities and actions with regard to increasing its activity and future role in the Region. The PITF has established the Preparatory Group to highlight relevant issues to be taken into account in the work of PITF and to arrange, in collaboration with the HELCOM Secretariat and governments, the Regional Workshops in the Baltic Sea countries devoted to the JCP Hot Spots.

The idea of arrangement of the HELCOM PITF Regional Workshops was to analyse the situation with regard to implementation of Element 3 of the JCP in the individual countries as well as in particular Hot Spots. Representatives of national, regional and local authorities and institutions as well as international and national financial institutions were invited to the discussions.

HELCOM PITF Regional Workshops in Poland

Two workshops were arranged in Poland. At the Sixth HELCOM PITF Regional Workshop, held in Cracow, on 25-26 September 2001, wastewater treatment plants and industrial plants located at the South of Poland were discussed. The Tenth HELCOM PITF Regional Workshop, held in Wroclaw on 8-9 October 2002, was devoted to presenting the situation of the rest of the Polish Hot Spots.

For each of the municipal and industrial Hot Spots study was carried out assessing the status with regard to the possible deletion from the JCP List and their impact on the environment as well as identifying necessary actions and planned investments. Timetable for deletion has been developed including proposal of dates when implementation of ecological activities will result in full compliance with relevant environmental requirements. This analysis is presented in an Attachment 2.

The Sixth HELCOM PITF Regional Workshop was organised under the auspices of the National Fund for Environmental Protection and Water Management and the representatives of the following entities took part in it: PITF Preparatory Group, HELCOM Secretariat, Finnish Environmental Institute, Ministry of the Environment of Poland, National Fund for Environmental Protection and Water Management, Regional Board for Water Management in Cracow, Regional Board for Water Management in Gdansk, Cracow Technical University, Polish Secretariat for the Helsinki Convention, Institute of Meteorology and Water Management (Katowice Branch), and Hot Spots.

Participants of the Tenth HELCOM PITF Regional Workshop included representatives of PITF Preparatory Group, HELCOM Secretariat, Danish Environmental Protection Agency, Ministry of the Environment of Poland, National Fund for Environmental Protection and Water Management, Regional Board for Water Management in Wroclaw, Polish Secretariat for the Helsinki Convention, and Hot Spots.

At the Workshops general conclusions were drawn and assessment was made with regard to Programme implementation:

- The Workshops reflected progress in the implementation of environmental developments in the Hot Spots located in Poland. Major results have been achieved. This includes the positive and engaged attitude of the responsible actors with regard to integrating environmental aspects into their decision-making. Still, there are tasks to be done and realistic plans for future pollution reduction measures were presented.
- The Joint Comprehensive Environmental Action Programme operates with a 20-year implementation period, and the impression from the Workshops was that it could be expected to see the deletion of the municipal and industrial Hot Spots in Poland before the end of that period.
- It was observed that the combination of the environmental fee and fine system and the environmental fund system functions very well.

Additionally, several observations were made:

- The economic burden on the enterprise due to the environmental investments it to a certain degree counteracted by the amount of fines saved after the investments have been implemented.
- During the implementation of actions the foreign investment has been rather low so far (about 6 %) while most investments originate from the enterprises themselves (46 %). The other sources have been: the ecological funds (25 %), the domestic state and commercial banks (13 %), state investments (5 %) and other sources (5 %). The state investments have been decreasing during the last years.
- The relatively low foreign contribution is to a certain degree surprising because one of the ideas of the JCP is to transfer resources from West to the East.
- The EU Water Framework Directive is expected to play a major role in the future environmental investments. According to the new Water Act the Polish river management plans require identification of water quality and sources of impacts ("hot spots") and financial measures have to be identified in relation to these.
- Substantial changes in the ownership of enterprises, closing of some of them and reduction of production in others as well as privatisation have lead to the improvements we observe today.
- The positive development of the environmental situation in Poland is positive not only from the point of view of the Baltic Sea but it will result in major improvements in Poland itself.

One important outcome of the Workshops has been the agreed opinion that some Hot Spots may now be ready for deletion from the List of Hot Spots and other Hot Spots will be ready within a few years.

After the Sixth HELCOM PITF Regional Workshop, by the decisions of PITF and HELCOM LAND, three discussed Hot Spots have been deleted from the List. As a result of the Tenth HELCOM PITF Regional Workshop, several more industrial plants and wastewater treatment plants have been proposed by Poland for deletion.

THEMATIC REPORT ON POLISH HOT SPOTS – TERMS OF REFERENCE

The Thematic Report has been elaborated on the basis of materials and conclusions from the HELCOM PITF Regional Workshops arranged in Poland as well as on information submitted directly by the hot spots. In order to present a complete overview of the JCP implementation with regard to Element 3, the Report includes also additional thematic presentations, touching upon a question of the system of fees and fines for the use of the environment and of sources of financing the investment projects in municipal treatment plants.

Due to the importance and participation of the National Fund for Environmental Protection and Water Management in financing the ecological investments in Poland, the role and contribution of the Fund to the improvement of the hot spots situation have been described. This section has been elaborated on the basis of presentation made by the Fund's representative at the Sixth HELCOM PITF Regional Workshop.

25 Polish municipal and industrial hot spots have been analysed. Each of them has been described with regard to:

- volume of the pollutant emissions;
- technology applied;
- degree of fulfilment of the environmental standards in force;
- curative measures taken;
- investment outlays implemented / planned;
- timetable and terms for deletion of hot spots from the JCP List.

Descriptions of particular wastewater treatment plants have been supplemented with wastewater treatment technology analysis.

The Thematic Report takes also into account changes introduced to the List after revision of the Polish hot spots. These changes concern the Katowice Area, initially formulated as Hot Spots Nos. 88, 107 and 108 without specifying any concrete enterprises. At present, according to the Polish proposal, Hot Spot No. 88 includes eight locations and covers also Hot Spots Nos. 107 and 108. Definitions and reasons for placement of those locations on the List have been provided in the Report.

A material on two specific hot spots: The Vistula Lagoon and the Szczecinski Lagoon (Hot Spot No. 73 and No. 113, respectively) has been elaborated on the basis of the Integrated Coastal Zone Management Plan for the Vistula Lagoon and Guidelines for Integrated Szczecinski Lagoon Coastal Zone Management, developed under the PITF MLW project. Additional information has been delivered by the Provincial Inspectorate for Environmental Protection, Elblag Branch (for Hot Spot No. 73).

Due to the ongoing process of the revision of the Polish agricultural hot spots, aiming at splitting large agricultural areas (Vistula river basin and Odra river basin) into smaller units (sub-hot spots), the Thematic Report only throws light on this issue. A Polish proposal is under evaluation and has not been fully presented and agreed upon in HELCOM.

Polish hot spots deleted from the List so far have been described in less detail comparing to hot spots in force, except those deleted lately (in 2002). Main developments in environmental protection which enabled hot spots deletion have been presented.

SYSTEM OF FEES AND FINES FOR THE USE OF THE ENVIRONMENT

Legal framework of the system of fees and fines in Poland

In reaction to recommendations put forward by the European Union and OECD, Poland has been for years introducing environmental protection regulations including various economic instruments aimed at the enforcement of the basic "polluter pays" principle and facilitating the reaching of maximum ecological results with limited financial outlays.

Economic instruments used in the OECD and the European Union countries include:

- fees:
  - for emission of pollutants;
  - for changes introduced to the environment;
  - for the use of nature;
- fines:
  - for failure to meet environmental protection requirements;
- other solutions:
  - subsidies for environmentally friendly projects, credit guarantees for green projects, ecological product fees, ecological deposits, insurance, trade in emissions (permits to emit pollutants).

The Polish environmental protection regulations include a number of acts introducing various economic instruments. The most important acts in this respect include the Environmental Protection Law, the Water Law, and the Waste Act.

The Environmental Protection Law Act of 27 April 2001 (*Dziennik Ustaw* [Journal of Laws] No. 62, It. 627) has been in force since 1 October 2001. Despite its formal equality with other legal acts, the act regulates the Polish environmental protection system. The act has replaced the Environmental Protection, Management and Planning Act of 1980 (with later amendments).

Similarly to its predecessor, the new act, i.e. the Environmental Protection Law includes the principle of legal responsibility in environmental protection, and a system of fees and fines. Provisions of the act are based on the more recent conceptual grounds - a number of previously unknown legal institutions have been introduced.

The Environmental Protection Law Act and the other acts mentioned above provide standards pertaining to the use of the environment by companies. This means that companies are obliged to obtain a permit to emit pollutants to the environment. Under the permit, its holder is also obliged to meet the conditions in the scope of the volume and type of pollutants emitted to the environment as specified in the document. The permit is granted under a decision of the appropriate authorities.

The acts in question introduce certain economic instruments as environmental protection mechanisms. The most important of these include:

- fees for the use of the environment and the introduction of changes to the environment;

- fines for the violation of the conditions ruling the use of the environment as specified in administrative decisions;
- other solutions, such as subsidies, preferential loans and credits for investment projects, environmental protection projects with funding coming from the fees and fines referred to above, and trade in emissions.

To supplement the above, it must be said that there are also other economic instruments, such as fees for the use of nature (including entry fees to the national parks and climate fees), or tax and customs duty relief and exemptions. However, their importance is much less significant.

Fees

Fees have to be paid by all companies using the environment. The fee is a payment for the use, pollution or introduction of changes to the environment. Under the Environmental Protection Law, special use of the environment, such as emission of substances or energy requires the payment of fees.

Companies are obliged to pay fees for:

- the use of water belonging to the state treasury;
- pollutants in the sewage discharged to water or soil;
- gas or dust emitted to the air;
- waste disposed of at a landfill site.

Fee amounts are calculated by the companies using the environment and are then paid to the account of the Marshall Office. Fees are determined by the Council of Ministers in ordinances. They are calculated in keeping with the list of fees in force on the date on which the environment is used, separately for each type of the use. The fees are included in the costs of manufacture.

An absence of a permit required under regulations in force does not constitute grounds for a penalty. In such a case under Art. 292 and 293 of the Environmental Protection Law the company is obliged to make increased payments to the Marshall Office. The following amounts are in force:

- 500 % for the emission of gas and dust to the air;
- 500 % for the intake of water and sewage disposal;
- 0.05 of the single fee for the disposal of waste at a landfill site per each day of storage.

Fees for the emission of pollutants (62 various substances) into the air are divided into three groups. The highest fees have been introduced for toxic pollutants (such as arsenic, benzene, asbestos, dioxins, mercury, cadmium, nickel). Fees for the discharge of waste water have been determined for six parameters: BOD_5, COD, total suspension, total heavy metals, total chloride and sulphate ions and volatile phenols. Fees for BOD_5 and COD depend on the branch of industry. Fees for the intake of surface and underground water vary considerably depending on the branch of industry.

Fees apply to all types of waste specified in the classification of waste. There are four levels of fees depending on the degree of waste-generated nuisance.

Along with fees for the disposal of waste at a landfill site, the waste act introduced fees for the period of storage. The regulations are aimed at limiting the amounts of waste stored at landfill sites and increasing their commercial use.

Administrative cash fines

Cash fines are imposed by the Provincial Inspector for Environmental Protection by way of a decision if it is discovered that a given company has violated the conditions in the scope of the use of the environment as specified in the permit.

Fines are imposed for:

- exceeding the amount or type of gas or dust emitted to the air as specified in the permit (does not apply to all companies);
- exceeding the amount, condition or composition of waste;
- drawing amounts of water exceeding those specified in the permit;
- violation of the conditions specified in the decision approving the landfill site operation manual or a decision specifying the place and manner of waste storage;
- exceeding noise levels specified in the permits.

The fines imposed for violation of the conditions of the use of the environment as specified in the decisions (*i.e.* permits issued to companies) are payable to the redistribution account of the provincial inspector. Fines are paid from the profits generated by the company. It is worth pointing out that Polish environmental protection regulations pertaining to the fines imposed for failure to comply with the requirements under which companies may use the environment are aimed primarily at inspiring investment processes.

There is a successfully functioning mechanism of postponing and redeeming the payment of fines if the penalised company implements investment projects protecting the environment and in consequence removes the reason for which the penalty was imposed.

System of environmental protection funds

The income resulting from the fees for the use of environment and administrative cash fines constitute a source of funding for environmental protection funds. Fines and fees are divided among the various funds in equal proportions.

Before the reform, Poland had the National Fund for Environmental Protection and Water Management, 49 provincial funds for environmental protection and water management, and approximately 2,500 communal funds for environmental protection and water management. After the reform the number of provincial funds was decreased from 49 to 16 and county funds for environmental protection and water management were introduced, resulting in the establishment of a four-level structure. Provincial funds are now subordinate to the Marshall of the Province, and the distribution of the income resulting from fees has changed.

Since 1999, 50 % of the income resulting from fees for waste storage have been directed to communal funds and 10 % to county funds. 20 % of the income from the other fees for the commercial use of the environment goes to communal funds and 10 % to county funds (with the exception of fees for NO_x and salty water – all of them go to the National Fund).

Communal funds	50 % F&F for landfilled waste; 20 % of other F&F (except those for NO_x emission and mining waters discharge)
County funds	10 % F&F (except as above)
The rest is shared by: **Provincial funds**	78 % (except as above)
National Fund for Environmental Protection and Water Management	100 % F&F for NO_x emission and mining waters discharge; 28 % of the rest F&F

28 % of the funds resulting from fees, which remain after the distribution are transferred to the National Fund and 72 % to provincial funds.

In the case of communes and counties in which the income of environmental protection funds exceeds 15-fold value of the national average income for the previous year per inhabitant, the surplus amount is to be transferred to the provincial fund.

Integrated system of financing environmental protection in Poland

Poland has had an integrated system of financing environmental protection for many years. Environmental protection funds and the Environmental Protection Bank (BOS) which co-operates with them play the basic role in the system. The income generated by the funds comes from fees and fines. The system aims at granting preferential loans, credits and subsidies to environmental protection projects.

The system is supported with funds from the central budget and the local budgets, ecological foundations, commercial banks, foreign assistance, also that provided in the form of eco-conversion (mainly through the Eco-Fund Foundation), from the PHARE programme and subsidies granted by individual countries. The system has been constantly evolving. New banks and investment funds decide to credit environmental protection projects and there is a growing co-operation between environmental protection funds and banks.

There is no doubt that the marked progress and environmental protection results achieved in the last years confirm the effectiveness of the integrated system of financing environmental protection in Poland, which among other things is based on the income from fees and fines.

Further evolution of the system is expected. Economic instruments will have to be changed so that market economy mechanisms are better utilised for the purposes of environmental protection, in order to shape environmentally-friendly behaviour of companies and the society as a whole.

FINANCING THE WATER PROTECTION INVESTMENTS BY THE NATIONAL FUND FOR ENVIRONMENTAL PROTECTION AND WATER MANAGEMENT

The National Fund for Environmental Protection and Water Management is a basic element of the environmental protection financing system in Poland. The system has been developed since 1989 and is an essential instrument of the National Environmental Policy, worked out by the Ministry of the Environment. The "National Environmental Policy" document defines directions and tasks in line with environmental requirements which must be undertaken in order to implement the idea of sustainable development and to fulfil Polish obligations with regard to the EU accession.

The objective of the National Fund is to provide financial support for environmental projects of national significance, with wider than local ecological effect. Smaller projects are dealt with by provincial, county and communal funds.

The National Fund applies the following forms of financial support to the water protection projects:

- preferential loans;
- subsidies and subsidies to bank credits;
- capital involvement.

The Fund can support a project financially up to 70 % of its value.

The basic form of financing from the Fund resources are loans offered on preferential terms (so called soft loans). Subsidies constitute a small part (several percent) of the total amount of money invested in the water protection sector. Subsidies to credits provided by a commercial bank, such as those practised by the Funds, cover the difference between the commercial interest rate of the bank and the preferential interest rate.

Another special form of preferential treatment, which is applied by the National Fund to borrowers is writing off of a part of the debt involved. It is applied to the borrowers who correctly fulfil the contract provisions with respect to the National Fund, especially if the borrower:

- has completed the project on time;
- has achieved the planned environmental effect;
- has paid off at least 75 % of the loan in accordance with the terms and conditions of the loan agreement;
- has met the conditions of paying fees and fines constituting the revenue of the National Fund.

Up till now one of the National Fund's priority programmes within the water protection section is „Removal of the Hot Spots within the Helsinki Convention", and the following investments were co-financed or have been financed by the Fund:

- "Debogorze" Wastewater Treatment Plant in Gdynia (Hot Spot No. 75);
- "Wschod" " Wastewater Treatment Plant in Gdansk (Hot Spot No. 76.1);
- "Fordon" Wastewater Treatment Plant in Bydgoszcz (Hot Spot No. 78);
- "Kapusciska" Wastewater Treatment Plant in Bydgoszcz (Hot Spot No. 79);

- Wastewater Treatment Plant in Torun (Hot Spot No. 80);
- “Anwil” Nitric Plants in Wloclawek (Hot Spot No. 81.1);
- “Poludnie” Wastewater Treatment Plant in Warsaw (Hot Spot No. 83.1);
- “Hajdow” Wastewater Treatment Plant in Lublin (Hot Spot No. 85);
- “Kujawy” Wastewater Treatment Plant in Cracow (Hot Spot No. 87.1);
- “Boruta” Dyestuff Industry Works and Municipal WWTP in Zgierz (Hot Spot No. 90);
- “Central” Wastewater Treatment Plant in Poznan (Hot Spot No. 99.1);
- “Lacza” Wastewater Treatment Plant in Zielona Gora (Hot Spot No. 101);
- Wastewater Treatment Plant in Wrocław (Hot Spot No. 103).

Thanks to the National Fund’s funding of water protection projects the related capacity of wastewater treatment plants increased to 5.3 million m^3/d, which is almost a half of all industrial and municipal wastewater discharged into the surface water.

The National Fund spent about EUR 156 million in 1999 for water protection projects, with subsidies amounting to 5,5 %.

230 contracts were signed in 2000, where the National Fund’s contribution amounted to about EUR 158 million).

During the period of 1989-2000 the National Fund’s expenditures on environmental protection amounted to about EUR 2.3 billion. The effects and results of these activities are clearly visible.

SOURCES OF FINANCING INVESTMENT PROJECTS IN MUNICIPAL SEWAGE TREATMENT PLANTS – ANALYSIS OF AVAILABILITY OF VARIOUS SOURCES AND THEIR USE IN THE JCP HOT SPOTS IN POLAND

Structure of sources of financing water management and water protection investment projects in cities as compared with other parts of Poland

In the year 2000 the outlays on enterprises in the scope of water protection and water management in Poland reached a total of approx. EUR 1,248.5 million. The basic sources of financing for this type of projects on the national scale included primarily investors' own funds (this applies to investors such as towns and cities, communes, water and sewage associations and companies) supported to a various degree by external sources, such as environmental protection and water management funds (which manage income generated from fees for the commercial use of the environment), foreign sources, banks, as well as units of the central and local government.

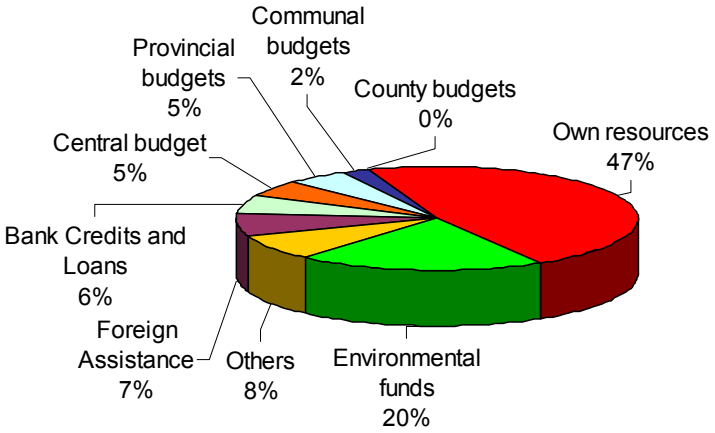


Figure 1. ***Share of different sources in the financing of investment outlays on water protection and water management in 2000.*** *(Source: data provided by the Central Statistical Office [GUS].)*

The structure of financing in cities and conurbations (where the biggest investment projects are carried out) is very similar. In this case investment-related expenses are principally paid by the city budget. To a large extent support in the form of preferential credits and subsidies from environmental protection funds as well as foreign funds, most of which come from the PHARE fund (although some cities/towns are about to commence investment projects supported by funds from the ISPA fund) are also used. The bank sources shown in figure 2. do not include loans or credits. They are mainly income resulting from issuing and selling municipal bonds, which constitute a cheaper source of funds closing an investment budget than a commercial bank credit.

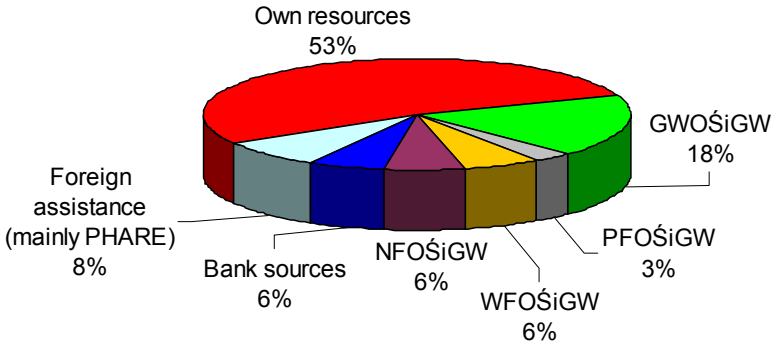


Figure 2. ***Share of different sources in the financing of investment outlays on water protection and water management in cities.***

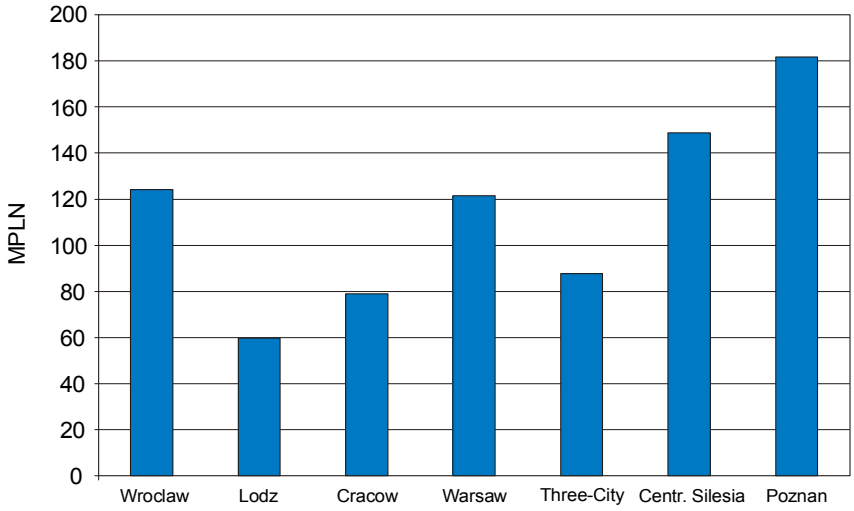


Figure 3. ***Investment outlays on water protection and water management in selected agglomerations in 2000.*** *(Source: data provided by the Central Statistical Office [GUS].)*

Availability of funds from external sources

Ecological funds created from fees for the commercial use of the environment are the cheapest and the most frequently used external source of financing environmentally friendly investment projects. Local governments of cities find it easiest to access the financial resources provided by county and communal environmental and water management funds. The funds are managed directly by town hall boards and are used towards the financing of projects aimed at environmental protection. The use of the funds poses no difficulties. Cities find it more difficult to obtain significant funds from loans granted by provincial environmental protection funds. The funds contribute finance to a number of investment projects in the region in which they function and due to a limited amount of funds at their disposal they are unable to allocate substantial funding to large individual projects (loans for the purposes of investment projects of the value amounting to approx. EUR 2.5-5 million cover a dozen or

so percent of the value, while the figure is approx. 50 % for smaller projects). The National Fund for Environmental Protection and Water Management has at its disposal bigger amounts than provincial funds. The difficulty in winning a loan from this source results from the number of applications filed and more demanding requirements in the scope of documentation preparation. Subsidies from both the national fund and the provincial funds are granted sporadically and only in exceptional cases – primarily when the budget no longer makes it possible for the commune / city to enter into new obligations.

Table 1. Availability of funds from external sources for the financing of investment projects in the scope of water protection and water management.

Source of financing	Availability of funds	Main difficulties hindering the use of funds as a source of financing municipal investment projects
GFOSiGW PFOSiGW	significant	No difficulties.
WFOSiGW	loans – medium subsidies – small	Considerable competition of local governments applying for the provision of some funds; too limited funds for large investment projects.
NFOSiGW	loans – medium subsidies – small	Considerable competition of entities applying for the provision of funds; rather difficult preparation of documents.
Banks	significant	Too high interest on credits and bonds; high additional fees and commissions.
Foreign funds	small	Long-lasting and complex procedure connected with the preparation of forms.

The availability of bank sources is quite different. There is a considerable supply of offers in this scope on the market. The fact that their use for the purposes of water and sewage management investment projects is limited results from significant costs connected with commercial investment credits and the servicing of bonds. City governments turn to banks only when they have to. Environmental Protection Bank is an exception here, as owing to its close co-operation with the national and the provincial environmental protection funds it provides flexible conditions of servicing water management investment projects. It is most difficult to obtain funds from big foreign programmes such as PHARE or ISPA. As it is possible to obtain some project funding (subsidies of up to several million EUR) for the purposes of projects with a very broad range of tasks or sometimes even for all the activities involved, they are exceptionally popular. However, the preparation of the appropriate documents requires significant investment of labour and capital. Costs of the preparation of documentation may amount to several dozen thousand PLN.

Table 3. *Selected sources of the financing of water protection and water management investment projects* attached at the end of the chapter shows examples of forms and principles of the provision of additional funds to enterprises by external sources.

Municipal investment projects in the light of European Union directives

The plan assumes that by the end of 2015 the Directive 91/271 of 21 May 1991 on treatment of municipal sewage will have been implemented. Deadlines for the implementation of the regulations vary and depend on the size of a conurbation – in consequence, they have to be adopted by the year 2015 at the latest. In the conurbations with more than 15,000 PE (there are 400 such conurbations in Poland), the duty to introduce a two-stage sewage treatment became effective in 2001. As a result of the implementation of the directive, collective sewer systems and sewage treatment plants will have to be built or (in the case of the existing ones) extended and modernised by 2015. The changes apply to 731 conventional biological sewage treatment plants and 279 treatment plants with an increased removal of nutrients. It is estimated that the total cost of the provision of treatment plants in conurbations and the extension and modernisation of collective sewer systems will amount to more than EUR 9 billion.

Sources of financing investment projects in the process of integration with the EU

The system of financing environmental protection investment projects will remain to be based on the elements used so far. Among them, internal funds and means provided by ecological funds such as the National Fund for Environmental Protection and Water Management and provincial funds for environmental protection and water management (credits, loans and subsidies) will play an important role. The system is supplemented with funds from internal budgets of provincial governors and communes, commercial banks, and ecological foundations. Increasingly important will be foreign aid, and in particular the European Union assistance programmes, including PHARE and ISPA, and in future the Cohesion Fund. Poland has a chance to obtain EUR 2 billion for sewage treatment projects from that source, especially for projects exceeding a value of EUR 10 billion.

Costs of investment projects in municipal Hot Spots

Financial analysis of Polish hot spots includes an analysis of data from all the Polish municipal hot spots with the exception of places connected with the area of Katowice (Hot Spot No. 88). The costs incurred towards investment projects in the scope of building or modernisation of sewage treatment plants from 1993 to 1999 amounted to approx. EUR 502.777 million. The planned costs of the indispensable investment projects for the years 2002-2009 amount to approx. EUR 860.337 million. An evaluation of the planned costs of investment projects shows that the projects will have to be significantly postponed. This is primarily connected with the evaluation of the trend line, *i.e.* the investment cost incurred and the anticipated expenditure. The volume of the investment projects planned shows unbalanced sources of financing. Realistically speaking, there will be a 3-year delay in carrying out the investment projects in hot spots due to limited capabilities.

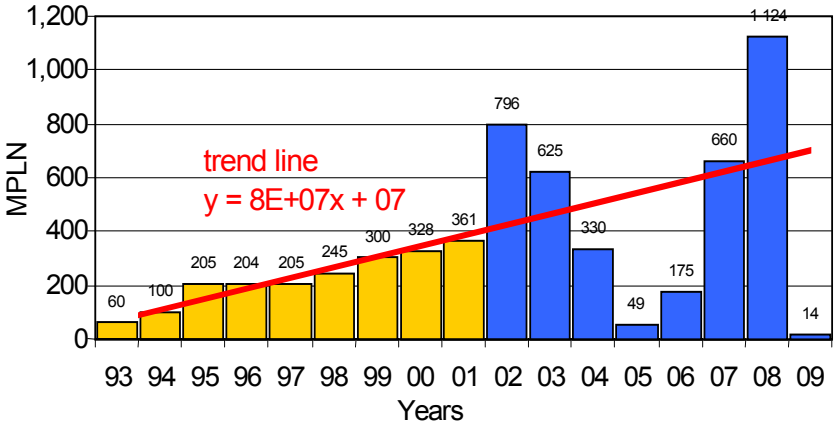


Figure 4. ***Costs of investment projects incurred and planned in municipal Hot Spots in Poland with the exception of the Katowice area.*** *(Source: data from the Hot Spot survey).*

Sources of financing investment projects in municipal Hot Spots

An analysis of the sources of financing investment projects shows that funds from the National Fund for Environmental Protection and Water Management as well as those from the provincial funds for environmental protection and water management are used to a considerable degree. The average share in investment projects of funds coming from fees for the use of environment amounts to 39 %. The highest share of such funds (66 %) was recorded in the town of Bydgoszcz, while the smallest one (21 %) during the implementation of a sewage treatment plant project in Zielona Gora. The average share of internal funds amounted to 32 %. The highest share of internal funds (as much as 53 %) was recorded in the "Kujawy" sewage treatment plant in Cracow, while the smallest one (19 %) in the "Wschod" sewage treatment plant for the city of Gdansk.

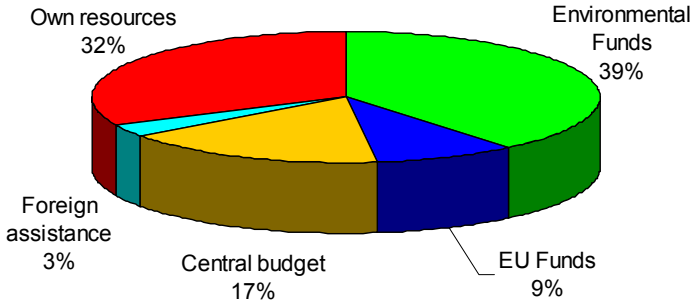


Figure 5. ***Sources of financing investment projects in municipal Hot Spots in Poland in 1993-2001.*** *(Source: data from the Hot Spot survey.)*

An analysis of the planned sources of financing the investment projects indicates a change in the policy of financing them. ISPA funds which are entering the market and structural funds connected with Poland's accession to the EU are used to the largest degree. The planned share of means

originating from funds for environmental protection and water management amounts to just 8 %. In hot spots, internal funds are to constitute as much as 55 % of investment project costs.

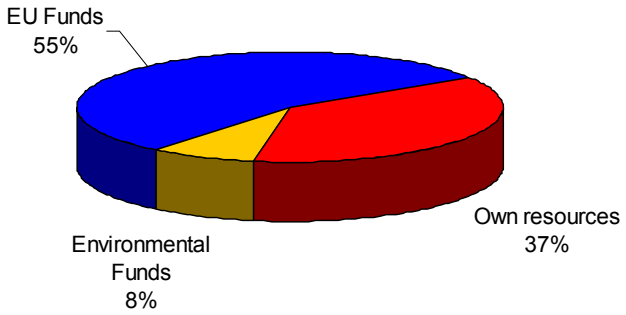


Figure 6. Planned sources of financing investment projects in municipal Hot Spots in Poland in 2002-2009. *(Source: data from the Hot Spot survey.)*

Investment project effectiveness

Unit costs of the modernisation of sewage treatment plants were one of the indices used for the assessment of the effectiveness of investment projects. The lowest cost of extension by one cubic meter of sewage was recorded in the Koszalin treatment plant, while the highest index of the planned unit costs was recorded in the Szczecin sewage treatment plant. Such a considerable difference in the planned unit costs in relation to the domestic average results among other things from the replacement and extension of the sewer system.

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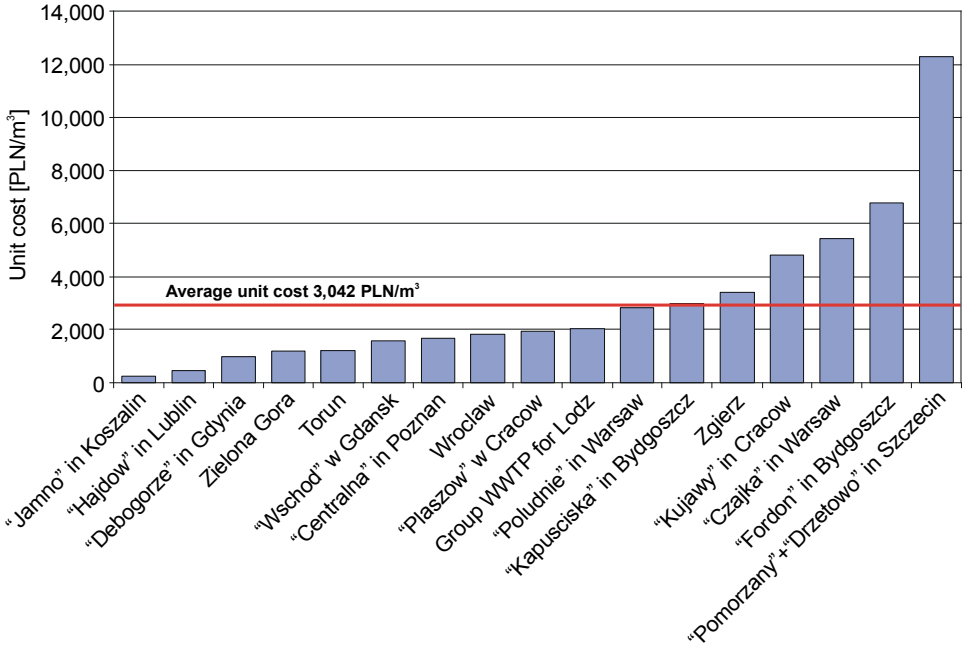


Figure 7. Unit costs of extension of wastewater treatment plants [PLN/m^3]. *(Source: data from the Hot Spot survey.)*

A study of June 1999 commissioned by the Ministry of Environment and entitled "Proposal of Activities Necessary for the Implementation of HELCOM Recommendations in the Scope of Revision of the JCP in Poland" showed a need for financing the extension of sewage treatment plants according to the priority resulting from an assessment of the degree of investment project effectiveness in terms of reduction of pollutants discharged to the Baltic Sea.

Table 2. List of priority investment projects in terms of reduction of pollutants discharged to the Baltic Sea.

Priority	Name
I	„Pomorzany" + "Zdroje" WWTPs – Szczecin
II	Torun WWTP
III	"Fordon" + "Kapusciska" WWTPs – Bydgoszcz
IV	"Wschod" WWTP – Gdansk
V	"Poludnie" WWTP – Warsaw
VI	"Central" WWTP – Poznan
VII	"Czajka" WWTP – Warsaw
VIII	"Hajdow" WWTP – Lublin
IX	"Group" WWTP – Lodz
X	Wroclaw WWTP
XI	Zielona Gora WWTP
XII	"Kujawy" + "Plaszow" WWTPs – Cracow

Basing the programme of financing investment projects in hot spots on the investment priority list attached would make it possible to accumulate funds and therefore implement the JCP in a more efficient way.

Conclusions

An analysis of costs incurred and planned in hot spots makes it possible to arrive at the following conclusions:

- The currently planned costs of investment projects in municipal hot spots in 2002-2009 (approx. EUR 860.337 million) are insufficient to eliminate all hot spots from the list.
- It would be difficult to implement investment projects in the hot spots and therefore they are likely to be postponed for three years.
- The anticipated high level of success in winning assistance funds from the European Union (55 % of all the investment projects) is hardly realistic.
- The fact that communal budgets are relatively low makes involvement of internal funds in the implementation of sewage treatment plant investment projects highly problematic.
- The absence of a central investment project priority policy based on the importance of projects makes it impossible to accumulate funds in order to use them effectively.
- As there is no division of the investment project financing tasks (sewage treatment plants versus extension of sanitary sewer systems), it is impossible to make a thorough analysis of investment project effectiveness.

- Relatively low fees for failing to comply with the environment protection standards do not motivate the achievement of effectiveness in the investment project business plans.

Table 3. Selected sources of financing the water protection and water management investment projects.

Source of financing	Form of contribution	Maximum funding of the project value	Maximum contribution in PLN	Loan / credit interest	Maximum crediting period	Other conditions
WFOSiGW in Wroclaw	loan / subsidy	50 % / 50 %	fixed individually	6-9 %	fixed individually	possibility to redeem 20 % of the loan value
WFOSiGW in Cracow	loan / subsidy	100 % / 40 %	15 million per task; 30 million per investor	0.4-0.8 of the bill of exchange rediscount rate, min. 6 %	fixed individually	possibility to redeem 50 % of the loan
WFOSiGW in Warsaw	loan / subsidy	70 % / 50 %	fixed individually	0.2-0.6 of the bill of exchange rediscount rate, min. 6 %	5 years	possibility to redeem from 20 % to 50 % of the loan
WFOSiGW in Gdansk	loan / subsidy	50 % / 50 %	fixed individually	0.3-0.5 of the bill of exchange rediscount rate, min. 5 %	6 years	possibility to redeem up to 50 % of the loan
WFOSiGW in Katowice	loan / subsidy	75 % in total	fixed individually	0.2-0.7 of the bill of exchange rediscount rate	10 years	possibility to redeem from 25 % to 50 % of the loan
WFOSiGW in Poznan	loan / subsidy	50 % / 50%	fixed individually	0.5 of the bill of exchange rediscount rate, min. 7 %	4 years	possibility to redeem up to 30 % of the loan
WFOSiGW in Szczecin	loan / subsidy	50 % / fixed individually	fixed individually	0.3-0.6 of the bill of exchange rediscount rate	fixed individually	possibility to redeem up to 30 % of the loan
NFOSiGW	loan / subsidy	70 % / fixed individually	fixed individually	0.1-0.5 of the bill of exchange rediscount rate	15 years	possibility to redeem up to 25 % of the loan
Environmental Protection Bank (BOS)	credit from the NFOSiGW line	50 %	750,000	0.4 of the bill of exchange rediscount rate	5 years	-
Bank Zachodni WBK	investment credit in PLN	-	-	WIBOR + bank commission	7 years	other fees and commissions
ING Bank Slaski S.A.	investment credit in PLN	80 %	-	WIBOR or 15.5 % + bank commission	fixed individually	0 % - 3 % commission on the credit granted + other fees and commissions
LG Petro Bank S.A	investment credit in PLN	70 % (minus funding provided by FOSiGW)	-	WIBOR + bank commission	fixed individually	0.2 % - 3 % commission on the credit granted + other fees and commissions

ANALYSIS OF WASTEWATER TREATMENT TECHNOLOGIES AT MUNICIPAL HOT SPOTS

Differentiation of technologies used at municipal Hot Spots is limited, especially when compared to variation of industrial branches and technologies. Taking this into account, detailed discussion of each particular Hot Spot has been replaced by an overview of technologies used presented below. Some hot spots deleted during the last 1-2 years were also included to make it more comprehensive.

The analysis is based on data contained in the information submitted in writing by the plant operators and aims at a general evaluation of the technologies used in terms of their potential for the removal of organic matter and nutrients.

The present study concerns both the treatment plants still remaining in the hot spot list and those which have already been deleted from the list. In the WWTPs which have been modernised the technology guarantees a compliance with the Polish regulations and should be able to guarantee the efficiency of pollutant removal as required under Directive 91/271/EEC. For other plants, the requirements are going to be satisfied after the completion of modernisation.

Zielona Gora ("Lacza" WWTP – Hot Spot No. 101)

Current sewage amount is approx. 52,000 m^3/d, number of inhabitants in the area serviced by the plant is approx. 110,000.

The mechanical treatment system does not include preliminary sedimentation tanks. The biological treatment system (activated sludge) consists of an oxygen-free tank and circulation tanks in which nitrification and denitrification processes take place in separate oxygen and low-oxygen-content zones. The appropriate control of the work of horizontal aerating rotors guarantees the appropriate control of the reach of the zones. The plant is equipped with a system for chemical support of biological dephosphatation.

Poznan (Central WWTP in Kozieglowy – Hot Spot No. 99.1, deleted)

Throughput is approx. 200,000 m^3/d.

Mechanical treatment includes sedimentation of organic suspended matter in preliminary sedimentation tanks. The preliminary sludge undergoes acid digestion in hydrolyser, and is subsequently concentrated in concentrator. The fluid from above the sludge from the concentrator, containing volatile fatty acids (VACs), is directed to biological treatment system to increase the effectiveness of biological dephosphatation and denitrification. The biological treatment system (activated sludge) was designed as a three-stage Bardenpho system with pre-denitrification of recirculated sludge (a system of an oxygen-free chamber, low oxygen content chamber and an oxygen chamber is located on the main sewage stream; a low oxygen content chamber is located on the

external recirculation stream). The plant is equipped with a system for the chemical support of biological removal of phosphorus.

Gdansk ("Wschod" WWTP – Hot Spot No. 76.1, deleted)

The current mean wastewater volume is approx. 90,000 m^3/d, the number of inhabitants in the area serviced by the plant is approx. 450,000.

Mechanical treatment includes sedimentation of organic suspended matter in preliminary sedimentation tanks. Approx. 50 % of the preliminary sludge undergoes acid digestion in a three-stage fermenter with full mixing. The sludge from the fermenter together with the volatile fatty acids (VACs) goes through preliminary sedimentation tanks. Biological treatment (activated sludge) takes place in a biological MUCT reactor (a modified system developed by the University of Cape Town). The plant is equipped with a system for chemical support of biological removal of phosphorus.

Zgierz (plant treating municipal sewage and wastewater from the "Boruta" plant – Hot Spot No. 90, deleted)

The current mean sewage amount is approx. 16,000 m^3/d (including approx. 2,500 m^3/d of industrial wastewater). Approx. 33,500 m^3/d of sewage gets to the plant via sewerage system, while the remaining amount is brought by sewage removal vehicles; the number of inhabitants in the area serviced by the plant is approx. 60,000.

Due to the type of the wastes (municipal sewage and industrial wastewater) the technological system is composed of two lines. Industrial wastewater undergoes preliminary treatment through mechanical and chemical pollutant removal (coagulation, sedimentation), and is subsequently mixed with pre-treated municipal sewage and directed to the biological treatment system. After the initial mechanical removal of bigger pollutants, municipal sewage undergoes sedimentation and preliminary digestion (generation of VACs). If necessary, municipal sewage may undergo preliminary chemical treatment. The mixed effluents are biologically treated in a multistage reactor with activated sludge with the help of the Bardenpho process (no information about the type of the Bardenpho process used). The treated wastewater is then filtered through sand filters.

Torun (municipal WWTP – Hot Spot No. 80, deleted)

The current wastewater volume directed to the plant amounts to approx. 90,000 m^3/d.

The mechanical sewage treatment includes sedimentation of suspended matter in preliminary sedimentation tanks. Biological sewage treatment system (activated sludge) consists of an oxygen-free chamber and circulation chambers, in which nitrification and denitrification take place. The division of the nitrification/denitrification chamber into oxygen and low-oxygen zones facilitates an automatic switching on and off of aeration rotors and the lifting of a mix of activated sludge and sewage in the reactor. The plant is equipped with a system for chemical support of biological removal of phosphorus.

Lodz ("Group" WWTP of the Lodz Agglomeration – Hot Spot No. 100)

The sewage treatment plant undergoes modernisation, which is planned to be completed in 2004. The target capacity amounts to approx. 275,000 m^3/d.

The mechanical sewage treatment includes sedimentation of suspended matter in preliminary sedimentation tanks. Biological treatment (activated sludge) will be based on biological reactors working in the MUCT system (a modified UCT system). Extension and modernisation of the biological sewage treatment facilities will include the rebuilding of 4 existing UCT systems into MUCT system and erection of 3 new MUCT systems.

Warsaw ("Poludnie" WWTP – Hot Spot No. 83.1)

Plant is under construction. Stage 1 is to be completed in the 3rd quarter of 2004. Intended capacity is 112,000 m^3/d (the treatment plant is going to service southern part of the left-bank Warsaw, *i.e.* approx. 25 % of the city area).

The treatment plant will treat sewage by mechanical, chemical and biological methods. Its technological system is going to be complex and rare. Apart from typical devices (such as screens and a grit chamber with a grease trap), the complex mechanic sewage treatment system is composed of devices for preliminary chemical precipitation of pollutants and sedimentation support: a chamber for the fast mixing of sewage with coagulant, a chamber for slow mixing (with polyelectrolyte dosage system) and multi-stream preliminary sedimentation tanks. The mechanical and chemical sewage pre-treatment system includes recirculation of sludge from preliminary sedimentation tank to slow-mixing chamber (chemical reactor). Fluid from above the sludge from concentrators and the mixture of wastewater and biological sludge from biological oily substances decomposition system (Biomaster) will be introduced to the biological treatment system, which will significantly enrich with volatile fatty acids the sewage directed to biological reactors.

The biological treatment system (activated sludge) is an original solution. It is composed of three basic zones: oxygen-free zone, low-oxygen content zone and oxygen zone, with the oxygen zone constituting a cascade of three aeration chambers. Two nitrate recirculation systems (internal recirculation) were designed: the first one goes from part one of the oxygen zone to low-oxygen content zone and the second one from part two of the oxygen zone to the low-oxygen content zone. There is no recirculation of the mixture of the activated sludge and sewage from the third part of the oxygen zone. The recirculation of the activated sludge from secondary settlement tanks (external recirculation) is directed to the beginning of the reactor, *i.e.* the oxygen-free zone. The design does not provide for a zone of denitrification of the recirculated sludge stream.

The construction of biological reactors in closed facilities and deodorisation of the outgoing air is by no means a typical solution in Poland. Practically all the elements of the sewage treatment and sludge lines will be erected in closed spaces and the outgoing air will be chemically purified through acid rinsing, rinsing in sodium hypochlorite and basic rinsing.

The design values for the concentration of nitrogen and phosphorus in treated effluents exceed the admissible values specified in Directive 91/271/EEC. However, it should be noticed that the report

included some relevant information in this scope and it was also said that designs modifying the adopted technology are being analysed.

Bydgoszcz ("Kapusciska" WWTP – Hot Spot No. 79, deleted)

The plant treating municipal sewage and industrial wastewater was built in 2001. The industrial wastewater is sent to the plant after being chemically pre-treated at the chemical plants in which it is produced. The throughput of the treatment plant amounts to approximately 72,000 m^3/d, and the actual amount of effluents is approx. 47,000 m^3/d (including approx. 31,000 m^3/d of municipal sewage and approx. 16,000 m^3/d of industrial wastewater). PE amounts to approx. 200,000.

The technological system is based on two independent lines for the mechanical and biological (activated sludge) removal of pollutants – line one is used for the treatment of municipal sewage and line two for the treatment of industrial wastewater. Before being introduced to receiving water, the treated effluents are mixed.

The line for the mechanical treatment of municipal sewage includes sedimentation in preliminary sedimentation tanks. Preliminary sludge is used for the generation of volatile fatty acids in sludge concentrators. The fluid from above the sludge and the sludge (containing VACs) from the concentrators is introduced through preliminary sedimentation tanks. Biological treatment of sewage is carried out by biological reactors of three-stage Bardenpho system with pre-denitrification of recirculated sludge.

The industrial wastewater treatment system is composed of a balancing tank with a 3-day detention time and a biological reactor. Biological (activated sludge) treatment of industrial wastewater is based on a standard removal of organic pollutants in oxygen conditions. The system of biological removal of organic compounds from industrial wastewater may be fed with excess activated sludge from the biological municipal sewage treatment system. It is also possible to direct the industrial wastewater after biological treatment to biological municipal sewage treatment system, although the selection of this option may have negative consequences for the functioning of the entire treatment plant.

The effectiveness of the municipal sewage treatment line should be able to guarantee the reaching of treated effluent parameters consistent with the requirements of Directive 91/271/EEC.

The effectiveness of pollutant elimination in the plant depends primarily on the quality of industrial wastewater and the effectiveness of the pre-treatment plant operating at the chemical plants. The treatment plant may meet the requirements of the Directive in relation to organic compounds, nitrogen and phosphorus, provided the pre-treatment plant operating at the chemical plants works effectively and provided the composition of industrial effluents is stable.

Summary

The world trends in the development of effluent treatment technologies during the last 20 years indicate that the use of an integrated removal of organic carbon (BOD_5, COD), as well as nitrogen and phosphorus in a single activated sludge process is the most frequently used method of biological removal of pollutants from the domestic and municipal sewage.

Intensive studies on the activated sludge process and technological experiments have resulted in the creation of various systems (based on both flow and cycles) facilitating a highly effective elimination of organic compounds and nutrients from the effluents in biological reactors with activated sludge. Very commonly used are three-stage systems such as a three-stage Bardenpho system or a three-stage Bardenpho system with modification consisting in the use of recirculated sludge pre-denitrification chamber. In practice, also some other effluent treatment systems are used, including UCT or MUCT, which is a modification on UCT, as well as circulation systems, in which nitrification and denitrification zones are shaped spatially during the flow through one and the same nitrification/denitrification chamber. Another variation of highly efficient activated sludge processes includes sequence reactors (SBR) and semi-sequence reactors (Biodenitro, Biodenipho), although flow bioreactors are used almost exclusively in large sewage treatment plants.

With good proportions between the concentration of organic compounds (BOD_5, COD) and nutrients (nitrogen, phosphorus), modern activated sludge systems effectively decrease the concentration of organic compounds (BOD_5 – up to several mg O_2/l, COD – up to several dozen mg O_2/l), nitrogen (up to 5 – 10 mg N_{tot}/l) and phosphorus (to approx. 0.5 – 1.5 mg P_{tot}/l) in effluents.

The equipment of effluent treatment systems with systems for chemical support of biological dephosphatation makes it possible to reach a stable (below 1 mg P_{tot}/l) concentration of phosphorus in the treated effluents. The global experience in the treatment of municipal sewage confirmed the purposefulness of biological removal of phosphorus – for this reason the removal of phosphorus with the help of solely chemical methods, still used in some countries (e.g. in Scandinavia) is not commonly used all over the world.

Problems with reaching high effectiveness of biological elimination of nitrogen and phosphorus connected with the unfavourable composition of raw sewage (low quotient values, e.g. BOD_5/N_{tot}, COD/P_{tot}), may be in the majority of cases significantly decreased owing to the use of processes aimed at the generation of volatile fatty acids (VACs) from preliminary sludge. Enrichment of the effluents directed to biological reactors with volatile fatty acids is possible through outfitting the treatment plants with VACs generation systems and makes it possible to reach high effectiveness of nitrogen and phosphorus removal, despite the relatively unfavourable composition of the incoming effluents.

For this reason sewage treatment plant solutions using the preliminary sedimentation of suspended matter have been preferred in recent years. The obtained “material” may then be used for the generation of volatile fatty acids from composite organic compounds contained in the sludge from the preliminary sedimentation tanks.

A solution involving chemical support of preliminary sedimentation with chemical precipitation of pollutants is not commonly used in the world. Although the method facilitates an effective decrease in

the concentration of phosphorus, in some cases it may lead to an unfavourable elimination of simple organic compounds from the effluents and cause a significant consumption of chemical reagents and the accumulation of large amounts of preliminary sludge.

In some cases the countries leading in the implementation of modern technologies aimed at the removal of pollutants from municipal sewage use additional treatment of biologically treated sewage, for example through filtration on sand beds. The processes have not been used in Poland yet, as they significantly increase investment costs and operating costs of treatment plants with the so-called third degree of sewage treatment. Polish sewage treatment plants are not equipped with facilities for the final disinfection of effluents, either.

The technological solutions applied in sewage treatment plants in question may be synthetically described as follows:

- 16 out of 18 plants in question are typical municipal WWTPs, while two of them (the "Kapusciska" treatment plant in Bydgoszcz and the Zgierz treatment plant) also receive wastewater from large industrial plants. Industrial wastewater is then treated in an independent process line (the "Kapusciska" plant in Bydgoszcz) or is mixed with municipal sewage before biological treatment (as is the case at the Zgierz plant);
- Preliminary sedimentation of pollutants is not used only in one case ("Lacza" treatment plant in Zielona Gora);
- Eleven reports submitted by plants included a description of the existing, designed or implemented activated sludge system:
  - a three-stage Bardenpho system with pre-denitrification of recirculated sludge is used in five treatment plants ("Kujawy" treatment plant in Cracow, Zgierz plant, "Kapusciska" plant in Bydgoszcz, "Debogorze" plant in Gdynia and "Central" plant in Poznan);
  - MUCT system is used in two treatment plants ("Wschod" plant in Gdansk and the "Group" WWTP of the Lodz Conglomeration);
  - MJHB system (or the three-stage Bardenpho system) is used in a single plant ("Fordon" in Bydgoszcz);
  - a system composed of an oxygen-free chamber and a circulation nitrification/denitrification chamber is used in two plants ("Lacza" in Zielona Gora and the Torun plant);
  - a complex and very extensive mechanical treatment system with an original biological treatment system is used at the "Poludnie" treatment plant in Warsaw;
- In the majority of treatment plants the biological dephosphatation may be simultaneously supported with chemicals;
- In three plants the process of preliminary sedimentation is supported with chemical precipitation (Wroclaw Treatment Plant in Wroclaw, probably "Czajka" in Warsaw, "Poludnie" in Warsaw).
- Seven WWTPs use processes generating volatile fatty acids (VACs):
  - five plants are equipped with systems generating VACs from preliminary sludge ("Wschod" in Gdansk, "Poludnie" in Warsaw, "Kapusciska" in Bydgoszcz, "Fordon" in Bydgoszcz, "Central" in Poznan);

- in two plants VACs are produced through the fermentation of the incoming sewage stream ("Debogorze" in Gdynia, Zgierz plant);

- In one case 3rd treatment stage (final filtration on sand filters) has been used (Zgierz plant);
- The treated effluents are not disinfected before being discharges to receiving water in any of the plants discussed.

The following basic conclusions have been drawn from a comparison of the synthetic information concerning the municipal sewage treatment technologies used throughout the world and a short description of the plants in question:

- The WWTPs in question use optimum municipal sewage treatment technologies, *i.e.* flow and single activated sludge systems facilitating integrated, biological removal of organic compounds, nitrogen and phosphorus to a degree making it possible to meet the requirements specified in Directive 91/271/EEC;
- The majority of plants (except one) use preliminary sedimentation, which is consistent with global trends and makes it possible to use preliminary sludge for the production of volatile fatty acids. Most plants are equipped with systems for chemical support of biological removal of phosphorus;
- Only one of the plants in question uses additional third-degree treatment of the outgoing sewage. Considering very high investment and operating cost as well as the sufficient potential effectiveness of the systems used for the mechanical and biological treatment, it seems that the introduction of the third treatment degree as a permanent element of process lines in the Polish WWTPs is not justified either from the economic or technical point of view.

MUNICIPAL HOT SPOTS

Poland is considered to be the major polluter of the Baltic Sea. However, to some extent this depend on the "scale effect". According to PLC-3 final report, Poland contributed to 25, 28 and 37 % of total riverine load of BOD_5, total nitrogen and total phosphorus, respectively[1]. The absolute load values were the highest in the Region. Still, the issue should not be considered apart from geographical and demographic situation. Poland covers 18 % of the total Baltic Sea catchment area. At the same time, Polish population makes a half of the total in the Baltic region. All the pollution parameters mentioned above are the lowest when related to the population (specific load per inhabitant) The specific area load is neither the highest nor significantly different from that of the other Baltic Sea countries.

Nevertheless, lack of sufficient investment and development activities in the 1945-1989 period resulted in the significant impact on the natural environment of the Baltic Sea, which was, and still is, exerted by Poland. Large improvement may be observed during the last years. This is due to introduction of the EU standards and regulations into the national law, as well as allocation of financial resources from the EU accession funds.

The socio-economic situation does not allow to mobilize all the necessary financial resources for environmental investment on municipal level. In spite of this, significant improvement in municipal wastewater treatment can be observed. The number of treatment plants serving the cities increased from 566 in 1990 to 965 in 1999. This went together with the improvement of treatment efficiency. The number of plants equipped with mechanical treatment only decreased from 199 to 53. Only 17 large municipalities (population exceeding 10,000 inhabitants) out of 412 were not served by wastewater treatment plants (WWTPs). Among 42 largest municipalities (population above 100,000 inhabitants) only one has no wastewater treatment and the next three are served by mechanical treatment only. The share of treated municipal and industrial wastewater increased from 57.7 % in 1980 and 67.4 % in 1990 to 88 % in 2000. The share of wastewater treated with biological methods and/or enhanced nutrients removal raised from 15.2 % to 53.4 % in 1980 and 2000, respectively[2].

The JCP Hot Spots List undergoes slow but systematic improvement resulting in deletion of seven Polish wastewater treatment plants from 2000 to 2002. Another eleven remain in the List, not taking into account four areas covered by Hot spot No. 88 Katowice Area. Although the investment activities have been started in each of them, various stages of development may be observed. Nevertheless, for 10 hot spots the timetable for deletion, when all the requirements are met, may be set.

"Jamno" WWTP in Koszalin (Hot Spot No. 74) is considered as close to deletion. All conditions necessary for that are fulfilled already now. The modernisation has been completed and technological start-up is planned to be terminated in December 2002. Both the designed efficiency and preliminary results from the start-up evidently show that all the requirements will be met.

Possible deletion of "Kujawy" WWTP in Cracow (Hot Spot No. 87.1) may be expected in the nearest future as well. High treatment efficiency was reached already in 2001, but development of sewerage was not completed at that time yet. The investment is expected to be finished by the end of 2002.

[1] "The Third Baltic Sea Pollution Compilation", Baltic Sea Environ. Proc. No. 70, HELCOM 1998
[2] "Environmental Protection" Central Statistical Office, 2002

According to the timetable of investment activities in the remaining eight municipal hot spots, the following plan for deletion may be proposed:

- Wroclaw WWTP (No. 103) – 2003;
- "Poludnie" WWTP in Warsaw (No. 83.1) – 2004;
- "Group" WWTP in Lodz (No. 100) – 2006;
- "Hajdow" WWTP in Lublin (No. 85) – 2006;
- „Plaszow" WWTP in Cracow (No. 87.1) – 2007;
- „Zdroje" WWTP in Szczecin (No. 97.2) – 2007;
- "Pomorzany" WWTP in Szczecin (No. 97.1) – 2008;
- "Czajka" WWTP in Warsaw (No. 82) – 2009.

It is important to mention that Warsaw strategy for municipal wastewater treatment has been substantially changed. WWTP „Pancerz" marked as Hot Spot No. 84 will not be constructed and wastewater stream will be directed to „Czajka" WWTP instead. The capacity of the latter is planned to be increased accordingly. However, the immediate deletion of Hot Spot No. 82 cannot be expected, as there is no doubt that wastewater discharged to the Vistula River is not properly treated. A common procedure for Nos. 82 and 84 should be applied in future.

A separate analysis of specific Katowice area was done. The region is a aggregation of a number of industrial and municipal point sources. Due to location on the border of the Vistula and Odra River catchment areas and the complicated sewerage, pollutants are discharged to both rivers.

From the timetable above it looks that there should be no Polish municipal hot spots in the List in 2010. The date may seem far in the future. On the other hand, in the very beginning of JCP it was clear that a lot of measures have to be taken and a mobilisation of financial resources should be spread in time. Due to this, the implementation of JCP was planned for 20 years, until 2012. If the activities at hot spots are not delayed, the JCP will be implemented on time.

"Jamno" WWTP in Koszalin – Hot Spot No. 74

WWTP "Jamno" receives all the sewage from the city of Koszalin, which means that it serves approximately 120,000 persons. Since not the whole city area is covered by the sewerage, some 10 % of the population is served by sewage-removal trucks. The total wastewater volume in 2001 was 11,626,000 m^3 (31,000 m^3/d).

The plant was put into operation already in 1995. It was equipped with two technological lines of mechanical and biological treatment. It was enough to reduce the organic pollution, suspended matter and phosphorus. Unfortunately, the efficiency regarding nitrogen removal was less than satisfactory as the outlet concentration was slightly below 30 mg N/l, which was however in compliance with the national law and water permit.

The modernisation of the plant started in 2000. It was focused on the development of biological unit (construction of denitrification chamber). In connection with the modernisation, the total plant's capacity increased to reach 40,000 m^3/d. All the work was successfully completed and the start-up of the reconstructed plant was finished in September 2002.

Table 4. Average concentration of pollution in effluent water over the years and reduction rate as of 2002.

	1997*	1998*	1999	2001**	1st half of 2002	
	concentration [mg/l]				[mg/l]	reduction [%]
BOD_5	8.7	7.4	6	36	2.75	99
COD	70	64	n.d.	69	16.1	98
N-tot	28	25	24	51	9.75	91
P-tot	1.2	0.83	0.8	1.7	0.28	98

* calculation

** all the parameters exceeded the permitted limit values, as due to reconstruction works one of two technological lines was put out of the operation

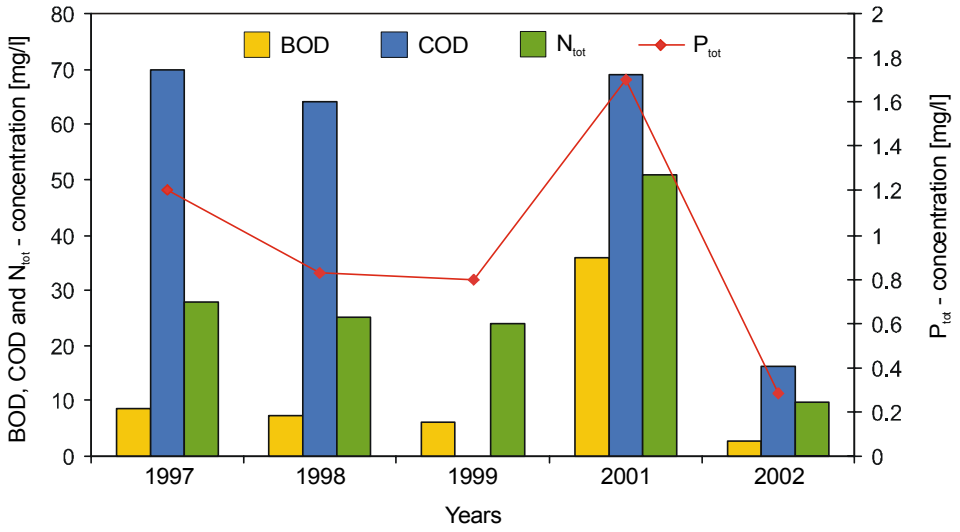


Figure 8. Average concentration of pollution in effluent water over the years.

Table 5. Compliance of outflow parameters (2002) with HELCOM and EU requirements.

	Outlet parameters			
	Reached by the plant		Required by	
	concentration [mg/l]	reduction [%]	HELCOM	EU
BOD_5	2.75	99	15 mg/l and 90 % reduction	25 mg/l or 70-90 % reduction
COD	16.1	98	—	125 mg/l or 75 % reduction
N-tot	9.75	91	10 mg/l or 70-80 % reduction	10 mg/l or 70-80 % reduction
P-tot	0.28	98	1.5 mg/l	1 mg/l or 80 % reduction

The efficiency of treatment is sufficient to reach full compliance will all the requirements specified in regulations concerning treatment of municipal wastewater, *i.e.* HELCOM Recommendations 9/2 and 16/9 as well as EU Directive 91/271/EEC.

Sludge management

The sludge produced in the amount of 10,000 tons annually is dewatered to 25 % dry weight and disposed of at the municipal landfill site outside the plant. The quality of sludge was examined for compliance with national requirements on heavy metals contamination (which are even more stringent than those set by Council Directive 86/278/EEC). Due to high quality and very low contamination of sludge it is possible to use it for compost production and agricultural purposes. Projects on the matter are being developed by the landfill site operator.

Table 6. Average concentration of heavy metals in sewage sludge.

	Actual concentration [mg/kg d.w.]	**Limit concentration when sludge is used for agricultural purposes [mg/kg d.w.]**
Lead	3.05	500
Cadmium	1.0	10
Chromium	141.0	500
Copper	66.3	800
Nickel	80.8	100
Zinc	321.0	2,500
Mercury	0.78	5

Investment cost and planned activity

The total modernisation costs reached approximately EUR 2.250 million (detailed information is not available yet as the investment has been just recently completed). Out of this sum approx. 50 % were covered by the city budget. The remaining part was shared by the National and Provincial Funds for Environmental Protection and Water Management.

In the coming years (until 2010) development of sewerage is planned. However, this will not result in significant change of wastewater volume treated since as it was mentioned in the foreword, the plant already serves the whole city area (by the sewerage or the sewage-removal trucks). Possible further sludge utilisation is discussed and considered as well.

Conclusions

According to the designed efficiency as well as preliminary results from the technological start-up, all the requirements of HELCOM Recommendations 9/2 and 16/9 will be met.

Wastewater Treatment Plants in Warsaw – Hot Spots Nos. 82, 83.1 and 84

Warsaw is inhabited by population of approx. 1.7 million and is located on the area of 488 km^2. The existing sewerage serves the area of approx. 150 km^2, out of which 66 % are served by combined sewerage and the remaining 33 % by a separate one. Altogether the sewerage reaches 92 % of the population.

Warsaw is located on the Vistula river banks. Eastern part with 231 km^2 makes 47 % of the total city area. On the right bank 50 km^2 is served by sewerage.

According to the municipal authorities, the strategic goals for wastewater management have been defined as follows:

- All areas with the population density exceeding 1,000 inhabitants/km^2 are to be served by municipal sewerage (which means that 98 % of the total population will be served);
- Efficiency of treatment technologies for the total volume of municipal wastewater should meet all the national and international requirements.
- The whole agglomeration has been divided into sub-basins:
    - East-bank Warsaw discharging to the existing "Czajka" WWTP;
    - Northern part of the west-bank Warsaw served with combined sewerage (wastewater will be directed to "Czajka" WWTP by collectors to be built under the river-bed);
    - The remaining part of the west-bank area served with separated sewerage discharging to "Poludnie" WWTP, which is under construction.

According to the above mentioned decisions, taken by the municipal authorities already in 1999, all the wastewater collected by the combined sewerage on both Vistula River banks will be treated by "Czajka" WWTP. This means deep reconsideration of the original strategy of wastewater management, which included construction of the additional "Pancerz" WWTP on the west-bank (identified as No. 84 on the Hot Spot List).

"Czajka" WWTP - Hot Spot No. 82 (including No. 84)

"Czajka" WWTP has been operating since 1991, however it was designed already in early 1970s. Due to this the plant was outdated from its start-up. Since then it undergoes permanent modernisation processes, *i.e.* development of new aeration system, introduction of chemical precipitation, development of sludge dewatering equipment as well as excessive sludge thickening station.

The designed plant capacity is 400,000 m^3/d, while the actual volume does not exceed 200,000 m^3/d. System of collectors and pump stations discharges wastewater from the whole right-bank part of the city. The plant serves 500,000 Warsaw inhabitants, about 31 % of the population. Mostly municipal wastewater is treated here. Only some 12 % of inflow comes from the industry, mainly pharmaceutical, chemical, food branches and car production.

From the technological point of view the plan is designed according to standards, with chemical precipitation on mechanical step. The mechanical step consists of grates, desanders, primary sedimentation tanks where chemical dephosphatation takes place as well. Within the biological step there are aeration tanks and secondary sedimentation tanks.

Table 7. Compliance of outflow parameters (2001) with HELCOM and EU requirements.

	Outlet parameters			
	Reached by the plant		Required by	
	concentration [mg/l]	reduction [%]	HELCOM	EU
BOD_5	12	93.9	15 mg/l and 90 % reduction	25 mg/l or 70-90 % reduction
COD	61	91.1	—	125 mg/l or 75 % reduction
N-tot	19.5	60.7	10 mg/l or 70-80 % reduction	10 mg/l or 70-80 % reduction
P-tot	1.34	88.9	1.5 mg/l	1 mg/l or 80 % reduction

Most parameters (BOD_5, COD, and total phosphorus) are consistent with the requirements, however for the total phosphorus only one of the EU alternative parameters is met. Nitrogen concentration is still too high, the obtained reduction is not satisfactory.

Sludge management

The following treatment is given to the sludge produced in the technological processes:

- primary sludge filtering,
- primary sludge gravitational thickening,
- excessive sludge mechanical (drum) thickening,
- methane fermentation (in separated fermentation chambers),
- sludge dewatering (centrifuges).

The sludge is further used for environmental purposes.

Investment cost

Total investment costs are estimated at approx. EUR 285,000 (excluding necessary expenses during the investment process). The WWTP management decided to apply for an ISPA donation.
At present several possibilities of financing are taken into account:

Option I

ISPA	71.4 %
loans	19.9 %
own sources	8.7 %

Option II

NFOSiGW	26.3 %
commercial loans	65.0 %
own sources	8.7 %

Option III

NFOSiGW	65 .0%
commercial loans	26.3 %
own sources	8.7 %

"Poludnie" WWTP - Hot Spot No. 83.1

"Poludnie" WWTP will be located in the commune of Warsaw-Wilanow. It is planned to serve 25 % of the city population and the same share of the city area. The surrounding city districts will supply it with mainly domestic wastewater, with a minor amount of industrial waste. The designed capacity is 112,000 m^3/d, however further development to 224,000 m^3/d is taken into account. Construction work started in 2000.

The plant will be developed step-wise:

1st stage	two technological lines with treatment capacity 56,000 m^3/d each – sufficient for the present volume of wastewater;
2nd stage (prospects)	3rd technological line which will expand the plant's capacity to 156,000 m^3/d
3rd stage (direction)	4th line which will expand the total capacity to 224,000 m^3/d.

The designed treatment technology does not differ from the widely used standard one. Produced sludge will undergo fermentation, dewatering and drying to 85 % dry weight. The sludge is intended to be incinerated in the Warsaw Heat and Power Plants.

The following treatment efficiency was originally planned:

Parameter	Reduction [%]	Outlet concentration [mg/l]	Load [t/year]
BOD_5	94	15	613
N-tot	62	15	613
P-tot	80	1.5	61

These parameters are in accordance with the valid water-use permit. They are however reconsidered now so as to meet all the HELCOM and EU requirements.

Investment cost

Total investment costs of the plant together with a system of collectors and accompanying equipment are estimated at EUR 158 million. The resources are provided by the European Investment Bank, National Fund for Environmental Protection and Water Management, ISPA and city budget. The share of sources is the following:

EIB	26 %
NFOSiGW	30 %
City of Warsaw	30 %
ISPA	14 %

The main difficulty is that the city budget is obliged to cover currently all the expenses and only later will they be repaid from the funds or a bank loan.

Perspective for deletion

Construction and start-up of "Poludnie" WWTP together with necessary connections is expected to be completed in the 3rd quarter of 2004. Possible deletion of Hot Spot No. 83.1 could be considered after that, provided the originally designed treatment efficiency is verified and upgraded.

As regards the deletion of Hot Spots Nos. 82 and 84, they are not to be considered before 2009, when "Czajka" WWTP is expected to meet all the requirements.

"Hajdow" WWTP in Lublin – Hot Spot No. 85

„Hajdow" WWTP serves an area inhabited by population of approx. 400,000 (450,000 PE) and treats the wastewater from the municipalities of Lublin and Swidnik (excl. industrial wastewater from the "Swidnik" Transport Equipment Manufacturing Plant) and the Wolka Lubelska commune.

The designed capacity is 165,000 m^3/day but after modernisation it will decrease to 120,000 m^3/day. The actual average wastewater volume is approx. 80,000 m^3/d.

WWTP operates with mechanical and biological steps, however it was not intended for enhanced nutrients removal. As a result, treatment efficiency with regard to nutrients is less than satisfactory.

Table 8. Average concentration and reduction rate of pollution in effluent water as of 2001.

Parameter	Concentration [mg/l]		Reduction [%]
	Inlet	Outlet	
BOD_5	344	8	97.7
COD	757	48	93.6
N_{tot}	73.1	26.2	64.1
P_{tot}	9.4	7.4	21.2

Sludge management

Sludge from wastewater treatment is fermented and thickened, and then undergoes mechanical dewatering at belt press. Sludge dewatered to average 25 % dry weight is dumped in prepared drying beds and further used for land reclamation. The use for agricultural purposes is not possible due to high concentration of heavy metals, especially cadmium and nickel. The total mass of sludge produced in 2001 was 24,625 tons.

Table 9. Average concentration of heavy metals in sewage sludge as of 2001.

	Concentration [mg/kg d.w.]
Chromium	123.94
Zinc	2,302.37
Cadmium	117.57
Copper	225.12
Ni	204.01
Lead	75.93

Investment activities and cost

Modernisation of the plant is aimed at improving the removal of nutrients. As the financial resources are limited, the designed treatment technology is intended to make best possible use of the existing equipment. Part of the investment has already been completed. This includes reconstruction of preliminary sedimentation tanks with accompanying collectors, reconstruction of aeration tanks to enable the nitrification and denitrification processes, modernisation of aeration conduits, installation of phosphorus removal unit, excessive sludge mechanical thickening unit. Visualisation and control system SCADA has been partly implemented. A half of the inflowing wastewater volume is already treated at the modernised part.

The following is still needed to be completed:

- Construction of the intermediate wastewater pumping station;
- Modernisation of the recirculate pumping station;
- Modernisation of the remaining 3 preliminary sedimentation tanks to transform them into anoxic chambers with predenitrification;
- Modernisation of the remaining 3 aeration units;
- Modernisation of the secondary sedimentation tanks.

All the investments are planned to be finalised by 2006. Then the environmental effect will be achieved and the nitrogen and phosphorus removal increased. This will allow to start the JCP Hot Spot deletion procedure.

The preliminary work was started already in 1992. In 1999 an application to ISPA fund was made. It was the EU experts' suggestion to include thermal drying of sludge into the project. The overall cost of the project is estimated at approx. EUR 23.08 million.

"Plaszow" WWTP in Cracow – Hot Spot No. 87.1

The first treatment plant was put into operation in 1974. Its capacity was 132,000 m^3/day. According to the plans it supposed to be a mechanical and biological treatment plant. However, due to economic reasons only the preliminary treatment and limited sediment management were put into operation. After then twice, in 1982 and 1987, preparations for modernisation were made. Again, due to lack of resources and weak enforcement of environmental protection, no measures were taken and treatment efficiency remains unchanged until now.

At present, the treatment plant consists of the treatment unit including:

- mechanical grates;
- grit chamber cleaned by digger;
- main pumping station;
- preliminary aeration tank;
- preliminary sedimentation tanks;

and the sludge processing unit including:

- raw sediment pumping station;
- closed fermentation chambers including a service building;

- dehydrating press station;
- drying beds.

For over twenty-five years the Municipal Water and Wastewater Company in Cracow (MPWiK S.A.) have made efforts in order to improve the treatment efficiency by low-cost investment measures. Coagulation prior to sedimentation has been introduced which reduced BOD_5, suspended matter and phosphorus loads discharged. The main facilities have been replaced (blowers, main pumps, grates) have been replaced, the filtration press reducing sludge production has been purchased and repairs have been carried out.

According to the measurements conducted from October to December 2000, the average amount of 172,000 m^3/d sewage flew into the treatment plant during the dry season. The maximum flow value recorded at the collector's outlet was 288,000 m^3/d. The treatment plant is currently overloaded. Certain amount of sewage over 7,000 m^3/h is overflowed without treatment, with the exception of several hours during the night. The purification effect of wastewater flowing through the treatment facilities is shown below.

Table 10. Average concentration and reduction rate of pollution in effluent water as of 1999 and 2000.

	1999		2000	
	Concentration [mg/l]	**Reduction [%]**	**Concentration [mg/l]**	**Reduction [%]**
BOD_5	110	55	120	52
COD	219	46	216	52
Suspended matter	89	49	117	45
N-tot	24.4	30	34.6	16
P-tot	2.8	48	2.6	57

Despite the efforts made the sewage quality does not comply with the requirements in force. The technological system does not allow to increase efficiency and to treat all flowing sewage. For this reason the water-use permission has not been granted which generates higher sewage charges and penalties for sewage disposal.

Financing of the investment

Since 1997 preparation for modernisation and development of "Plaszow" WWTP has been undertaken. Conceptual design and a preliminary cost analysis have been prepared. Costs have been estimated at EUR 75 million so the ISPA fund has become a great chance for this investment. As a result of strong efforts, the IPSA fund has been granted.

The preliminary investment costs are EUR 80 million. EUR 56 million will be covered by the ISPA grant, while EUR 20 million are planned to be borrowed from European Bank for Reconstruction and Development. The remaining EUR 4 million are to be covered from the company's own resources.

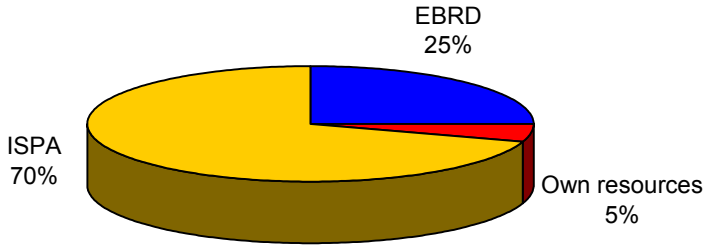


Figure 9. Sources of financing investments planned at the Hot Spot.

The project is intended to result in a complete and modern treatment plant, the efficiency of which will meet all the national and international requirements. This includes the capacity of the facilities as well as reduction of pollution from wastewater. As the combined sewerage is predominant in the Cracow area, the plant's capacity has to be sufficient even for extreme flow of rainwater.

The average capacity of reconstructed plant will reach 165,000 m^3/d. At sludge unit an advanced sludge utilisation is planned, including fermentation, dewatering, drying and preparation for further utilisation.

Plant's modernisation which, in practice, is construction of a completely new WWTP, was planned for the period 2002 – 2005, to be followed by the necessary technological start-up. The possible deletion may be considered after 1 January 2007.

"Kujawy" WWTP in Cracow – Hot Spot No. 87.2

The "Kujawy" WWTP serves the *Nowa Huta* district covered by sewerage separate from the one serving the remaining parts of Cracow. *Nowa Huta,* featuring population of 200,000 inhabitants, was built in the 1950s and comprises a metallurgical complex and a housing estate. For decades untreated sewage from this system was released into the Vistula River. In 1991 the treatment plant construction was started as a joint investment between the Cracow Community and the "Tadeusz Sendzimir" Steel Plant.

The "Kujawy" was originally designed to cope with 100,000 m^3/d of sewage influx during dry weather, while twice this amount would be treated biologically and four times - mechanically during wet weather. A decrease in potable water consumption was observed during the building phase. Therefore it was decided to complete the plant in stages.

The first stage was completed in 1999 and it comprised: the preliminary treatment unit, one (out of two) biological treatment (nitrification/denitrification/ biodephosphatation) unit supplemented with an installation for chemical precipitation of phosphorus. Some sludge treatment facilities (fermentation and belt press dewatering) were constructed as well. Infrastructure and other facilities were completed

as designed. The fall in wastewater production was so radical, that the capacity reached in the 1st stage was sufficient for treatment of the inflowing volume. An important consequence of water consumption drop was the increase of the inflowing wastewater load. To ensure the appropriate treatment efficiency, the plant's capacity was reduced from 100,000 m^3/d (reached after completion of the 1st stage) to 80,000 m^3/d. However, even this limited capacity is sufficient for building development within the drainage area and sewerage development at the system peripheries.

The average inflow in 2001 varied during dry weather between 47,000 and 53,000 m^3/d. The maximum registered inflow during wet weather reached 85,000 m^3/d.

Table 11. Compliance of outflow parameters (1st half of 2001) with HELCOM and EU requirements.

	Outlet parameters			
	Reached by the plant		**Required by**	
	concentration [mg/l]	**reduction [%]**	**HELCOM**	**EU**
BOD_5	11.8	96	15 mg/l and 90 % reduction	25 mg/l or 70-90 % reduction
COD	22.0	95	—	125 mg/l or 75 % reduction
N-tot	4.4	88	10 mg/l or 70-80 % reduction	10 mg/l or 70-80 % reduction
P-tot	0.9	86	1.5 mg/l	1 mg/l or 80 % reduction

Treatment efficiency is satisfactory and all the requirements are met.

Sludge management

Sewage sludge is exposed to methane fermentation and is dehydrated on filter presses (up to 30% of dry matter). The sludge, produced in the amount of 63 t, is transported to a disposal site in the Silesia region.

Investment activities and cost

The second stage of the treatment plant is currently under construction, including:

- Systems to deal with wastewater from the surrounding areas not covered by sewerage yet as well as from the western part of Cracow (to reduce the necessary capacity of "Plaszow" WWTP);
- Stabilisation of process by cubage enlargement and increased sewage oxidation; modification of the denitrification and dephosphation; minimisation of the chemical precipitation;
- Development of sludge unit to enable complete fermentation and increase of the natural gas production (natural gas will be used for electric power generation).

This stage, to be finished by the end of 2002, will complete the "Kujawy" Wastewater Treatment Plant. Wastewater collected by the *Nowa Huta* district system will be efficiently and properly treated.

The total cost of 1st stage was approx. EUR 30 million, while the 2nd stage is estimated at EUR 10 million. Altogether it makes approx. EUR 40 million.

The investment is, in general, financed from the national sources. The total amount of budget sources (MPWiK SA, the Cracow Municipality, "T. Sendzimir" Steel Plant) is EUR 23.25 million. Loans from National and Provincial Funds for Environmental Protection and Water Management will cover the remaining EUR 15.3 million (EUR 11.5 and 3.7 million, respectively).

It is worth mentioning that in 1991-1992 technical help from the Kruger-Consult Company, Denmark, was financed within the PHARE programme. The Kruger-Consult Company verified and modified the Polish sewage line project, and also prepared a sewage sludge treatment line. Before the first stage had been finished, the Danish Environmental Protection Agency also stepped in with assistance. Total amount of financial assistance: approx. EUR 1 million.

"Pomorzany" WWTP - Hot Spot No. 97.1 and "Zdroje" WWTP - Hot Spot No. 97.2 in Szczecin

The wastewater management system existing in Szczecin is neither operational nor consistent with the environment protection requirements. Main problems are: discharge of insufficiently treated wastewater from existing mechanical treatment plants, lack of sanitary sewerage at large parts of the city, use of rainwater sewerage for municipal wastewater collection resulting in discharges if untreated sewage directly to the Odra River. The overall poor condition of sewerage is an important problem as well.

The population of Szczecin is close to 415,000 inhabitants. Approx. 97 % of the population is served by sewerage, which covers approx. 80 % of the city area. The average wastewater volume in 1999 was 93,000 m^3/d with downward trend and reached 85,000 m^3/d in 2001.

Wastewater treatment plants located in the west-bank part of the city ("Gorny Brzeg", "Dolny Brzeg" and "Grabow") collect 72.5 % of the total registered wastewater volume. However, the facilities are outdated - some of them have been in operation for approx. 100 years - and do not provide proper treatment. The remaining plants in this part of the city ("Dabrowki", "Dzielnicowa", "Brzecze") were constructed as temporary ones as a result of underdevelopment of the centralised sewerage serving the whole city. They do not exert any significant impact in the scale of the city.

"Zdroje" WWTP, supplied with 15 % of wastewater volume, is the only important one. The construction was interrupted due to lack of financial resources and it provides mechanical treatment only. BOD reduction does not exceed 30 %, or up to 60 % when chemically supported. Treatment efficiency as regards other parameters is the following:

COD	up to 65 %
N-tot	up to 40 %
P-tot	up to 55 %

It should be noted, that even the mechanical stage treatment (completed in 1980s) is not fully operational and needs modernisation, especially as regards sludge management. Two other WWTPs located on the east bank of Odra River are temporary ones with no significant impact on the municipal

wastewater management, similarly to those on the west bank. As regards the whole municipality, reduction of BOD load is approx. 10 %.

A comprehensive "Improvement of water quality in Szczecin" program has been elaborated to solve the problem of wastewater management. It consists of two stages:

Stage I:
- intended for the years 2002–2004:
  - Construction of sewerage at *Pomorzany* district together with construction of pumping stations and modernisation of sewerage in the catchment of „Pomorzany" WWTP

Stage II:
- intended for the years 2003–2008:
  - Construction of the mechanical-biological "Pomorzany" WWTP (66,000 m^3/d capacity) together with accompanying facilities (collectors, pumping stations *etc.*);
  - Construction of the biological stage and modernisation of the existing mechanical-chemical "Zdroje" WWTP (18,000 m^3/d capacity) together with accompanying facilities (collectors, pumping stations *etc.*);
  - Construction of the sludge dryers at both plants and the sludge incineration plant at "Pomorzany" WWTP.

The designed treatment technologies ensure that effluent quality will satisfy the national, EU and HELCOM requirements. If the investments are not delayed, the environmental effect is expected to be reached by 2007 as regards "Zdroje" WWTP and 2008 as regards "Pomorzany" WWTP.

Stage I of the project has already in 2000 been approved for co-financing from ISPA Fund, while the final decision as regards Stage II has not been made yet (the procedure is going on). Total investment cost is estimated at EUR 250 million, incl. EUR 47.5 million for Stage I (66 % covered by ISPA) and EUR 210.5 million for stage II (application for 66 % from ISPA made).

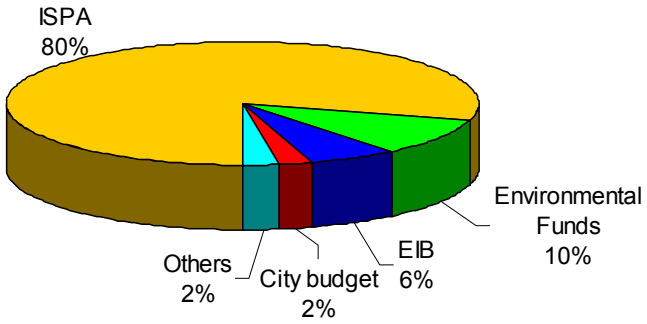


Figure 10. Sources of financing investments planned at the Hot Spot (provided that both stages are supported by ISPA).

It should be noted, that values mentioned above do not include investment recovery costs or interests for the loans. It these are included, the total cost of investment exceeds EUR 375 million.

"Left River Bank" WWTP in Poznan – Hot Spot No. 99.2

The Left River Bank WWTP in Poznan serves the municipality together with Central WWTP (Hot Spot 99.1, deleted in May 2002). Both plants treat the total volume of wastewater from Poznan, out of which 33 %, *i.e.* 18,500 m^3/d, is directed to the Left River Bank WWTP. Sewerage covers 97 % of the city at present.

The existing Left River Bank WWTP is a mechanical-chemical one, therefore the treatment efficiency is not satisfactory.

Table 12. Average concentration (2001) and reduction rate of pollution (over the years) in wastewater over the years.

	1999	2000	2001		
	Reduction [%]		Inflow [mg/l]	Outflow [mg/l]	Reduction [%]
COD_{Cr}	57.19	54.62	910.79	377.46	58.56
BOD_5	52.51	52.93	420.52	222.53	47.08
Susp. matter	87.28	81.63	376.91	75.41	79.99
N-tot	11.77	11.86	83.12	71.72	13.71
P-tot	57.44	47.04	8.8	3.62	58.9

Complete reconstruction of the WWTP is planned, including the increase of capacity to 50,000 m^3/d during the dry weather and 80,000 m^3/d during wet weather (*i.e.* 350,000 – 560,000 PE). When the modernisation is completed, the plant will operate with mechanical and biological treatment with a possible chemical support. The mechanical unit is going to be modernised. Biological reactors and secondary sedimentation tanks will be constructed which will ensure high reduction of organic matter, nitrogen and phosphorus.

Sludge management

Sludge from the primary sedimentation undergoes two-stage fermentation (first in closed, then in open fermentation chambers) and then is directed to drying beds. Dried sludge is utilised for environmental purposes. Natural gas produced during the fermentation is collected and used for in-plant heat production.

Table 13 Average concentration of heavy metals in sewage sludge.

	Concentration as of 2001	Concentration as of 2002 (1st–3rd quarter)	Limit values when sludge is used for agricultural purposes (Polish norms)
	[mg/kg d.w.]		
Lead	106	53.5	500
Cadmium	5.4	1.3	10
Chromium	285	130	500
Copper	780	369.9	800
Nickel	73.6	56.0	100
Mercury	2.6	1.7	5
Zinc	1,253	861	2,500

After the modernisation, thickeners-fermenters and a mechanical thickening unit will be constructed. Sludge will then undergo 1-stage fermentation in closed chambers. The fermented sludge will be pumped to Central WWTP for further dewatering and drying.

"Group" WWTP in Lodz Agglomeration – Hot Spot No. 100

Construction of the "Group" Sewage Treatment Plant for the Lodz Agglomeration covers the construction of a WWTP in Lodz to be completed by the end of December 2004. Sewage will be treated mechanically and biologically. Each of the lines comprises an oxygen-free tank (biological dephosphatation), two oxygen-free tanks (biological denitrification and preliminary denitrification of the recirculated sludge) and one aeration tank (nitrification and oxidation of organic compounds). Mean capacity of the plant will amount to 275,000 m^3/d for dry days and 300,000 m^3/d for rainy days.

After erection, the sewage treatment plant together with transport collectors built by the individual communes will provide services for approx. 900,000 people from:

- Lodz – 790,000 inhabitants (91% of the citizens use the municipal sewerage system);
- Pabianice – 74,000 inhabitants;
- Konstantynow Lodzki – 18,000 inhabitants;
- Ksawerow, Nowosolna, Pabianice and Rzgow communes.

The completed facilities will make it possible to receive all sewage from the above mentioned towns and communes. The outlet parameters will meet the Polish standards and EU directives. Additionally, construction of a heat and power generation plant will make it possible to use natural gas for generation of heat and electricity for the treatment plant.

Table 14. Average concentration and reduction rate of pollution in wastewater as of 2001.

	Inlet	**Outlet**	**Reduction [%]**
	Concentration [mg/l]		
BOD_5	211.10	23.34	88.9
COD	460.77	68.39	85.2
Suspended matter	201.39	41.35	79.5
N-tot	50.54	28.83	43.0
$N\text{-}NH_4$	28.82	8.73	69.7
P-tot	7.43	2.64	64.5
$Phenols_{vol}$	0.085	0.037	
Pb	0.0002	n.d.	
Hg	0.0003	n.d.	
Cu	0.0850	0.0305	
Cd	0.0002	n.d.	
Zn	0.5548	0.1840	
Cr^{+3}	0.0297	n.d.	
Cr^{+6}	n.d.	n.d.	
Ni	0.0568	0.0037	

As	n.d.	n.d.	
Fe-tot	n.a.	0.720	

n.d. – not detected; n.a. – not analysed

The values relate to total wastewater volume, both biologically and partly treated.

When the investment is completed, all the national and international requirements will be met.

Financing of the investment

Table 15. Sources of financing of completed investment at the Hot Spot.

Source	Millions of EUR
Municipal budget	25.9
State budget	31.4
Provincial Fund for Environmental Protection and Water Management (subsidy)	1.0
Other subsidies	1.0
Provincial Fund for Environmental Protection and Water Management (loan)	5.0
National Fund for Environmental Protection and Water Management (loan)	12.5
Environment Protection Bank (loan)	1.25

Outlays in 2002-2005 will be EUR 45.3 million at the level of prices in the fourth quarter of 2001, which is 36.7 % of the total project outlays. It is estimated that the financing sources will be as follows:

Table 16. Sources of financing of planned investment at the Hot Spot.

Sources	Millions of EUR
Municipal budget	12.9
State budget	3.5
National and Provincial Funds For Environmental Protection and Water Management (loan)	2.6
ISPA (subsidy)	77,573
EIB (loan)	6.9

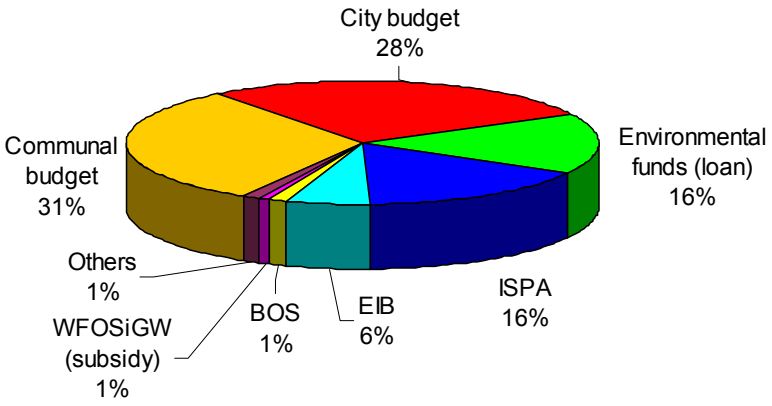


Figure 11. Sources of financing investments at the Hot Spot (completed and planned stages together).

Wroclaw WWTP – Hot Spot No. 103

Wroclaw WWTP is a modern mechanical-biological plant with enhanced nutrients removal. Plant's capacity is 70,000 m^3/d and it equals the actual volume of wastewater supplied. This is approx. 60 % of wastewater produced. The remaining part is treated at irrigation beds.

First construction work was started as early as 1976. As a result of some difficulties, mainly of financial character, the investment was delayed. The acceleration began in 1992, due to a subsidy from the National Fund.

The following treatment facilities were put into operation over the years:

- 1996 – part of mechanical stage (grates, desanders, pumping stations);
- 1998 – the remaining part of mechanical stage (separation chamber and primary sedimentation tanks) and part of sludge management unit (gravitational thickeners, mechanical thickening facilities, emergency sludge tank);
- 2000 – biological stage (with secondary sedimentation tanks), sludge fermentation chambers and gas management facilities (*i.e.* natural gas collection system, gas tank, electricity generators supplied with gas and heat recovery equipment).

Technological start-up was completed in July 2001. The biological stage was designed in such a way that not only organic matter, but nutrients are reduced as well. Chemical dephosphatation was planned to be used only in emergency. However, due to the high pollution load, a coagulating agent is added already before the primary sedimentation tanks to improve the quality of wastewater directed to the biological unit.

Table 17. Compliance of outflow parameters (2002) with HELCOM and EU requirements.

	Outlet parameters		
	Concentration reached by the plant [mg/l]	Required by	
		HELCOM	EU
BOD_5	9.0-10.0	15 mg/l and 90 % reduction	25 mg/l or 70-90 % reduction
COD	33.0-41.0	—	125 mg/l or 75 % reduction
N-tot	9.0-10.7	10 mg/l or 70-80 % reduction	10 mg/l or 70-80 % reduction
P-tot	1.1-1.2	1.5 mg/l	1 mg/l or 80 % reduction

Sludge management

Solid wastes from treatment processes (sand, grates) are deposited on the landfill site operated by the plant. The landfill site is managed in the best way, leakages are directed to the WWTP. The site is monitored and operated according to legal requirements.

Financing of the investment

The total investment cost amounted to EUR 41.25 million and the following sources were engaged:

- National Fund for Environmental Protection and Water Management;
- State budget;
- City of Wroclaw;
- Own resources of the water and wastewater company.

Katowice Area – Hot Spots Nos. 88.1, 88.2, 88.3, 88.4

Katowice Area is the most heavily industrialised and densely populated part of Poland. Covering less than 4 % of the country area, it's inhabited by over 12 % of the Polish population. Due to the reduction of industrial impact on the environment, resulting from the investment measures as well as decrease of production, a shift in the potential negative impact is observed from industrial to municipal wastewater. In the Silesia Region, still 65.7 million hm^3 (13.6 %) of wastewater is untreated and only 43 % (178.8 hm^3) of treated wastewater undergoes biological treatment with an advanced nutrients removal.

Bytom Municipal Enterprise (BPK Bytom) – Hot Spot No. 88.1

Municipalities served by the Enterprise: Bytom and Radzionkow.
Number of people in the region served by the Enterprise: 220,000.
Number of people connected to the sewerage system: 198,000.
Number of people served by wastewater treatment plants: 209,000.

Wastewater in the region is discharged to Bytomka River, belonging to the Odra River catchment area and Szarlejka River in the Vistula catchment area.

Table 18. Wastewater treatment plants operated by BPK Bytom.

WWTP/ type/ operated since	Capacity [m^3/d]		Loads discharged in year 2000 [tons]	Comments
"Srodmiescie" m 1939	28,000	BOD_5 N-tot P-tot	650.8 176.6 36.8	To be closed.
"Radzionkow" m 1965	5,000	BOD_5 N-tot P-tot	299.9 83.8 16.0	Upgrading by biological step to 40,000 m^3/d capacity.
"Lagiewniki" m-b 1912	1,300	BOD_5 N-tot P-tot	35.7 14.0 2.6	Overloaded; to be closed.
"Miechowice" m-b 1994	18,000	BOD_5 N-tot P-tot	18.1 10.4	Upgrading by NP removal.
"Bobrek" m-b 1934/ 1971	1,400	BOD_5 N-tot P-tot	9.4 6.2 1.1	Upgrading to 3,500 m^3/d capacity.
"Rozbark" m-b 1968	340	BOD_5 N-tot P-tot		To be closed.
"Szombierki" m 1966	1,400	BOD_5 N-tot P-tot	133.3 28.7 5.7	To be closed.

m – mechanical treatment; m-b – mechanical-biological treatment

In order to solve the problem of wastewater management in Bytom, it is intended to connect the entire municipality to three wastewater treatment plants: "Radzionkow", "Miechowice" and "Bobrek" (to be modernised) as well as to develop new sewerage linking Bytom with the Radzionkow wastewater treatment plant. The remaining three WWTPs are planned to be closed.

Waterworks and Sewerage Enterprise (PWiK) in Gliwice – Hot Spot No. 88.2

Administrative units (communes) served by the Enterprise: Gliwice, Sosnicowice and Pyskowice.

Number of people in the region served by the Enterprise: 239,000.
Number of people connected to the sewerage system: 211,000.
Number of people served by wastewater treatment plants: 122 ,000.

Wastewater in the region is discharged to the Klodnica River and the Gliwice Channel belonging to the Odra River catchment area.

Table 19. Wastewater treatment plants operated by PWiK Gliwice.

WWTP/ type/ operated since	Capacity (m^3/d)		Loads discharged in the year 2000 [tons]	Comments
"Gliwice-Centrum" m 1905	22,500	BOD_5 N-tot P-tot	801.5 180.4 30.3	Upgrading.
"Gliwice-Centrum" m-b +NP 2001	51,000	BOD_5 N-tot P-tot		Start up.
"Sosnica" m 1987	2,700	BOD_5 N-tot P-tot	170.3 28.0 6.1	To be closed.
"Labedy" m-b 1989	1,800	BOD_5 N-tot P-tot		Upgrading to 2,500 m^3/d capacity.
"Smolnica" m-b 1996	200	BOD_5 N-tot P-tot	2.6 1.5 0.5	Good working.
"Pyskowice" m.-b	2,900	BOD_5 N-tot P-tot	12.9 25.0 4.7	
"Hektablok" m.-b	1,400	BOD_5 N-tot P-tot	12.1 15.0 2.3	

m - mechanical treatment; m-b - mechanical-biological treatment; m-b +NP - with advanced nutrient removal

Annual load of untreated wastewater discharged directly to the recipient is about 600 tons BOD_5, 100 tons total nitrogen and 29 tons total phosphorus. The problem will be solved when the new "Centrum" treatment plant becomes fully operational and the collection system is built.

Regional Enterprise of Waterworks and Sewerage (RPWiK) in Katowice – Hot Spot No. 88.3

Administrative units (communes) served by the Enterprise: Katowice, Siemianowice and Myslowice.

Number of people in the region served by the Enterprise: 490,000.
Number of people connected to the sewerage system: 450,000.
Number of people served by wastewater treatment plants: 311,000.

Wastewater in the region are discharged to Bolina, Brynica, Przemsza, Rawa and Mleczna Rivers located in the Vistula catchment area and Klodnica River within the Odra catchment.

Table 20. Wastewater treatment plants operated by RPWIK Katowice.

WWTP/ type/ operated since	Capacity [m^3/d]		Loads discharged in the year 2000 [tons]	Comments
"Szopienice" m 1964		BOD_5 N-tot	54.2 14.9	
"Dabrowka" m 1964				To be closed; wastewater will be directed to "Gigablok".
"Janow" m 1972	500	BOD_5 N-tot P-tot	5.1 5.8 1.7	Good working.
"Giszowie" m-b 1987	12,000	BOD_5 N-tot P-tot	289.1 145.8 33.4	Bad working.
"Gigablok" m-b 1983	40,000	BOD_5 N-tot P-tot	278.1 276.8 15.4	Good working with regard to BOD removal.
"Kostuchna" m-b 1992	1,800			
"Panewniki" m-b 1992/ 1995	20,000	BOD_5 N-tot P-tot	138.9 89.3 16.5	Good working.
"Podlesie" m-b 1982	13,000	BOD_5 N-tot P-tot	30.9 65.1 16.4	Good working.
"Dabrowka Mala" m-b 1988/ 1990		BOD_5 N-tot P-tot		
Siemianowice "Centrum" m-b +NP 1988/ 1990	70,000	BOD_5 N-tot P-tot	257.8 449.6 61.8	Good working in BOD removal.

The remaining problems are: lack of the nutrient removal at treatment plants, insufficient length of collectors transferring wastewater to the plant, discharge of untreated wastewater (mainly from the town of Myslowice).

Regional Centre of Water and Wastewater Management in Tychy – Hot Spot No. 88.4

Administrative units (communes) served by the Enterprise: Tychy.

Number of people in the region served by the Enterprise: 131,000.
Number of people connected to the sewerage system: 101,450.
Number of people served by wastewater treatment plant: 131,000.

Wastewater in the region is discharged to the Gostynka river (Vistula catchment area).

Wastewater from Tychy is treated in the "Urbanowice" mechanical and biological treatment plant, operating since 1972. The treatment plant was modernised in 1994. Current capacity of the mechanical stage reaches 160,000 m^3/d, while 33,000 m^3/d undergoes biological treatment.

In the year 2000 loads of pollution discharged by WWTP “Urbanowice” to Gostynka River were: 1,121 t of BOD_5, 872 t of total nitrogen and 112 t of total phosphorus.

Further modernisation of WWTP aimed at improving the operation and introducing advanced nutrient removal is planned to be completed in the nearest future.

INDUSTRIAL HOT SPOTS

Industrial activity cannot be separated from the impact on the environment. Reduction of that impact is within the scope of the state economic policy. In the last decade a constant improvement of the environmental situation in Poland has been observed. The real growth of industrial production went together with positive changes in the environmental impact. The latter is reflected in the reduction of air and wastewater emission, decrease of water consumption for industrial purposes, improvement of industrial wastewater treatment and utilisation of the solid waste.

The reduction of adverse impact in the environment was achieved by implementation of:

- strategic priorities set in the industrial and environmental policies;
- legal, economic and organisational measures;
- investment and modernisation.

Minimisation of pollution was further supported by the development and implementation of detailed sector programs. The most important areas were the following:

- Change of production profiles, reduction of the energy, fuel, material and water consumption, reduction the production of solid waste.
- Introduction of modern technologies where environmental issues are taken into account, modernisation and automatisation of the processes, manufacture of more environmentally friendly products.
- Increase of waste utilisation, use of less contaminated fuels, increased dedusting of flux gasses, reduction of all the loads discharged to surface water bodies.
- Development of flux gasses desulphurisation at the power and heat and power generating plants, development of the coal enrichment and desulphurisation units at coal mines, modernisation and/or introduction of electrofilters at the power and heat and power plants, modernisation of the municipal and communal heating systems, decommissioning of small, old and local heating plants; removal of salt from mine waters.
- Development and modernisation of the wastewater treatment plants.

Introduction of the Best Available Techniques (BAT), including the best economically reasonable technologies, is considered as important as investments aimed at the reduction of pollution. BAT introduction is supported by legal measures, especially those transposed into the national system from the EU legislation. However, voluntary agreements become important in this respect as well.

The Baltic Sea catchment area is a highly industrialised region with big differentiation of activities. The environmental impact of industrial sectors varies a lot as well. This includes the use of natural resources and discharge of pollution. Recommendations of the Helsinki Commission belong to the system of measures aimed at the reduction of the adverse impact on the environment resulting from the industrial activities. Poland, as a Contracting Party to the Convention, undertakes to minimise that impact as much as possible so as to reduce the deterioration of the ecological state of the Baltic Sea.

HELCOM Recommendations constitute a milestone in the development programs for specific branches of industry. Their implementation is one of the key issues in the State Environmental Policy and is supported by various measures. Reduction of the use of natural resources, investments and modernisation, and in some cases reduction of production volumes or even total abandonment are considered to be among the most important ones.

Environmental requirements are introduced by legal measures which strongly motivate the industry to proceed its development in a more environmentally friendly direction or way. This is a market demand as well, that less material-consuming and less waste-producing technologies become dominant. As a result, pollution emission is decreasing and an impact is reduced at a source. National and international voluntary agreements and programs become more popular. Year by year more enterprises introduce environmental management system based on the ISO 14001 standards.

Requirements and provisions of the Helsinki Convention are implemented by national legal measures. This will largely be improved due to adoption of new acts during 2001-2002, *i.e.*, Environmental Protection Law Act, Water Law, Waste Act. The subsequent executive orders transpose detailed requirements into the national legal system. It may be stated that full implementation of the national regulations will allow to consider the provisions of the Helsinki Convention implemented as well.

All the presented point sources of industrial pollution follow the national requirements and have their use of environment regulated in the form of permits issued by appropriate authorities. As a result of the investments and modernisation completed, the national and HELCOM requirements are mostly observed. Modern production technologies and environmental protection systems allow to minimise the pollution loads discharged to the atmosphere and water bodies, as well as to reduce the impact and amount of the solid waste produced. In most cases they are consistent with the BAT standards.

The site closest to deletion is Hot Spot No. 104, *i.e.* "Rokita" Chemical Plant in Brzeg Dolny. The environmental effect of the investment is expected to be achieved in 2003.

The situation concerning Hot Spot No. 87.2 ("Tadeusz Sendzimir" Steel Plant in Cracow) is complicated, although the only remaining problem is dust emission form the not modernised part of the cokery. However, restructurisation plans for the whole Polish iron-and-steel industry do not allow for long-term investment programs. Due to that, timeframe for deletion cannot be clearly indicated.

It seems that "Organika–Azot" Chemical Plant in Jaworzno is the biggest problem (Hot Spot No. 89). Contaminated land reclamation and safe liquidation of the old and unsafe hazardous waste dump sites are estimated to cost approx. EUR 25 million. This is far beyond the capacity of the Company itself.

The national legal system of environment protection is considered to be complicated and strict. Still, the AOX and toxicity monitoring in wastewater is not yet mandatory for industrial plants. This obligation is included in the executive order to the Environment Protection Law, which will come into force in the near future. Therefore, the information presented does not contain data on these parameters.

"Tadeusz Sendzimir" Steel Plant in Cracow – Hot Spot No. 87.2

General description

The decision on a metallurgic company – the "Tadeusz Sendzimir" Steel Plant (HTS) - construction in the Cracow area was made over fifty years ago.

The plant was originally designed to produce 1.5 million tons of steel. It was an industrial plant having a complete production cycle with a number of units assisting the steel production (supplying with energy, refractory materials and fluxing agents, steel constructions) and equipped with its own rail transport. At this very early stage, its influence on the environment was not significant. Waste management was rational – coke-oven gas and blast-furnace gas was used on the spot, blast furnace slag was used for cement production in an adjacent plant.

At a later stage of development the production was excessively extended. The environmental protection was neglected and the HTS, producing 7 million tons of steel in the 1970s, was a synonym of an environmental "polluter". A fall in production in the 1980s and creation of the plant's environmental service was a turning point in the field of environmental protection – the quantitative impact on the environment was constantly decreasing and the crucial investments were started. Some of the most outdated and hazardous processes were gradually phased out.

The fundamental coking plant product is coke for the blast furnaces and sinter plant. Coke-oven gas is treated and used for the HTS internal purposes. The coking process products as well as the gas treatment products are sold outside. The mill's products are: hot-rolled sheet steel, cold-rolled sheet steel, tinplated or zinc coated sheet steel and welded tubes.

Water and wastewater management

According to the initial project, materials and products were intended to be transported by water. Therefore, the *Przewoz* stage of fall and the Wet Dock in *Pleszow*, connected with the Vistula River, were built. Water absstracted for the production was released untreated to the Vistula River and the Dlubnia River. Closing the internal water circulation resulted in positive changes in the water management. The substantial improvement was observed at the end of 1980s when the final waste water treatment plants were built (at the "Poludniowy" Channel and the "Suchy Jar" Channel).

The overall water circulation in the HTS is a closed system. Industrial sewage, treated in the final treatment plants, is driven back to the main industrial water intake.

In 2000 the discharged industrial sewage was at a level of 0.12 m^3/s, much less then in 1998 - 0.52 m^3/s, (the year when the sewage circuit was closed). Water abstraction from the Vistula River supplements losses in the water cycle caused by evaporation.

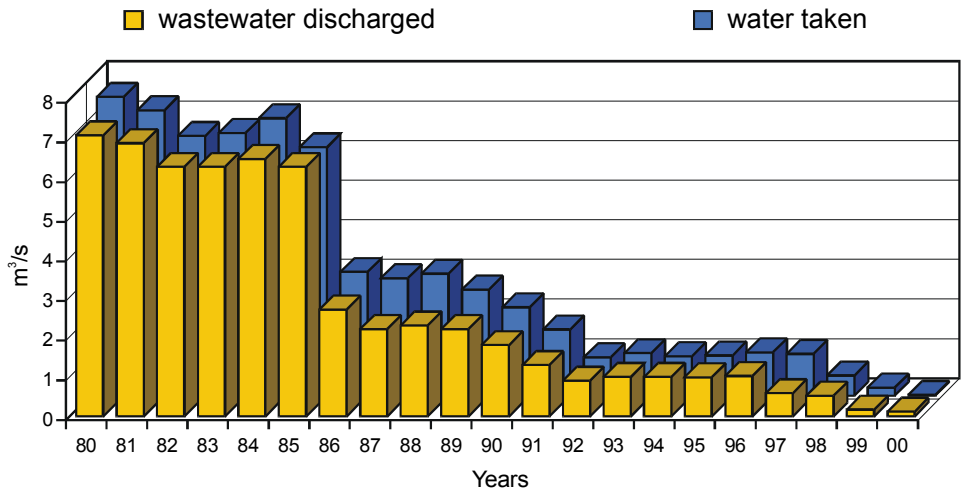


Figure 12. Amounts of water intake and wastewater discharged in 1980-2000.

Ammonia and phenol-contaminated wastewater from the cokery processes is directed to the Biological Wastewater Treatment Plant, where the activated sludge method is applied. Other streams are directed to industrial treatment plants at the "Poludniowy" and "Suchy Jar" Channels.

Neither the cokery nor the steel processing units have separate discharge points to the receiving water bodies, therefore there is no possibility to make a direct reference to the requirements of HELCOM Recommendations 17/4 and 17/5. Outflow parameters may be balanced for all the Plant's units together.

Table 21. Annual average specific load and outlet concentrations (1999) in comparison with limit values set in HELCOM Recommendation 17/4.

Parameter	Reached by the plant		Required by HELCOM	
	specific load [g/t coke]	concentration [mg/l]	specific load [g/t coke]	concentration [mg/l]
COD	87	—	100	
Total suspended matter	68	—		
$N\text{-}NH_4$	—	3.71		30
Phenols	—	0.028		0.3
CN^-_{vol}	—	0.009		0.1

Table 22. Annual average specific load (1999) in comparison with limit values set in HELCOM Recommendation 17/5.

	Reached by the plant	Required by HELCOM
	specific load [g/t steel]	
Suspended matter	68	10 (50)*
Oil	8	5 (10)*
CN^-_{vol}	0.04	0.2**

* value for hot rolling; **for iron blast furnace

Sludge from the Biological Wastewater Treatment Plant is utilised in the cokery process by its batching with blend of coal to the coking chamber.

Emission to atmosphere

Since 1968 the environmental service has been recording the atmospheric pollution. Initially, as the production was increasing, the emissions increased. Since the end of 1970s gas and dust emissions have been constantly dropping, as a result of: introduction of new technologies, more efficient dust collection devices, using less polluted materials.

At the end of the 1980s a radical improvement in the impact on the air was observed. The decision about closing down half of the material part of the mill was taken at the end of the 1980s, and consequently, the production decreased by 50 %. The restructuring process was also started, as well as the intensive modernisation process.

All the processes mentioned above have caused a fall in emissions:

- Dust by 93 %;
- SO_2 by 78 %;
- NO_2 by 73 %;
- CO by 88 %;
- C_nH_m by 96 %.

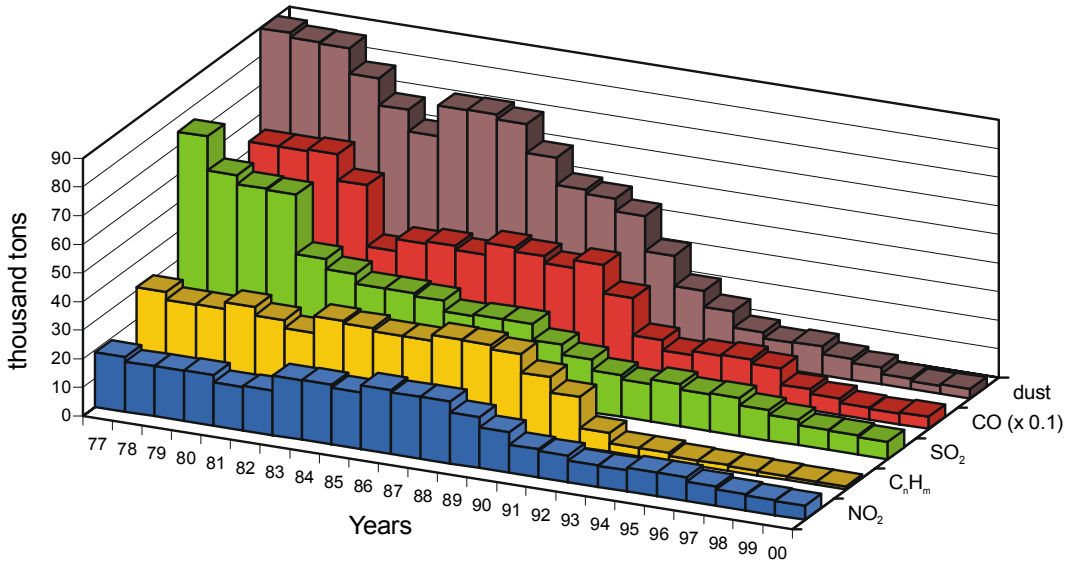


Figure 13. Dynamics of pollution emission changes in 1977-2000.

That decrease was also supported by:

- Increase of the average dust removal efficiency from 83 % to 97 %;
- Decrease of consumption of high-sulphur coal;

- Flux gasses conditioning in the power house;
- Decrease of blast-furnace gas losses;
- Reduction of the No. 5 blast furnace emissions;
- Decrease of sinter belt emissions (through modern filters);

and by many other initiatives of the restructuring process, modernisation the technology and the implementation of modern protection measures.

The organised emission has been regularly monitored for several years now. An exception is the cokery unit where no monitoring is conducted. Cadmium emission is below 0.1 g/h, total particulate matter emission amounts on average to 1-2 kg/h.

Table 23. Particulate matter concentration in process gases (1999) in comparison with limit values set in HELCOM Recommendation 11/7.

Emitter	Concentration [mg/Nm^3]	
	Reached by the plant	**Required by HELCOM**
Sintering plants	30-57	10 (50)
Blast furnaces	7-18	10 (50)
Furnaces	52-61	10 (50)
Power Plant's Boilers	38-61	10 (50)

HTS operates one PWR-53d type coke oven battery with dry quenching and two RWR-51 batteries with wet quenching. Coke dust is pulled off from emission sources by means of ventilation systems and dedusted in dust collectors. Gases from the cokery process are cleaned and directed back to the system. The PWR-63d battery operates with dry quenching operation and is equipped with electro-filters of 99 % efficiency.

Table 24. Dust emission from coke production (1999) in comparison with limit values set in HELCOM Recommendation 17/4.

Type of process	Reached by the plant		Required by HELCOM
	mg/m^3	**g/t coke**	
Dry quenching (PWR-53d)	14.7–15.7	26.2	50 mg/m^3
Wet quenching (PWR-51)	-	76.6	80 g/t coke

Total emission from individual processes is balanced by means of the indicators developed for the Polish cokery by the Institute of Environmental Engineering. However, the air emission limit values for wet quenching processes set by HELCOM Recommendation 17/4 are not observed.

Emissions in 2000 were (in comparison with the issued limit values):
- Dust – 3,259 t (3,320 t);
- SO_2 – 6,027 t (6,566 t);
- NO_2 – 4,934 t (5,305 t);
- CO – 42,054 t (42,321 t);
- C_nH_m – 349 t (445 t).

Waste management

Over the 50 years of the HTS operation significant amounts of waste have been deposited in landfill sites. Two companies have been appointed to deal with the waste issues.

A number of different waste types are generated as a result of the complexity of production process, including:

- blast furnace slag;
- metallurgical slag;
- iron-bearing dust and sludge;
- fly ashes;
- scale;
- used refractory materials.

Most waste, out of over 110 different types, are harmful to the environment (containing oils, heavy metals – Mn, Pb, Cr, Cd, Zn, Cu, Ni, Al, asbestos, phenols, tar substances).

Some of the waste (used oils, scale, tar waste, skull, zinciferous waste, $FeSO_4$, Fe_2O_3, blast furnace slag, Bessemer slag, mill slag), are re-used up to 100 %. Other waste, including debris, used refractory materials, sludge from treatment plants are disposed at the HTS' landfills.

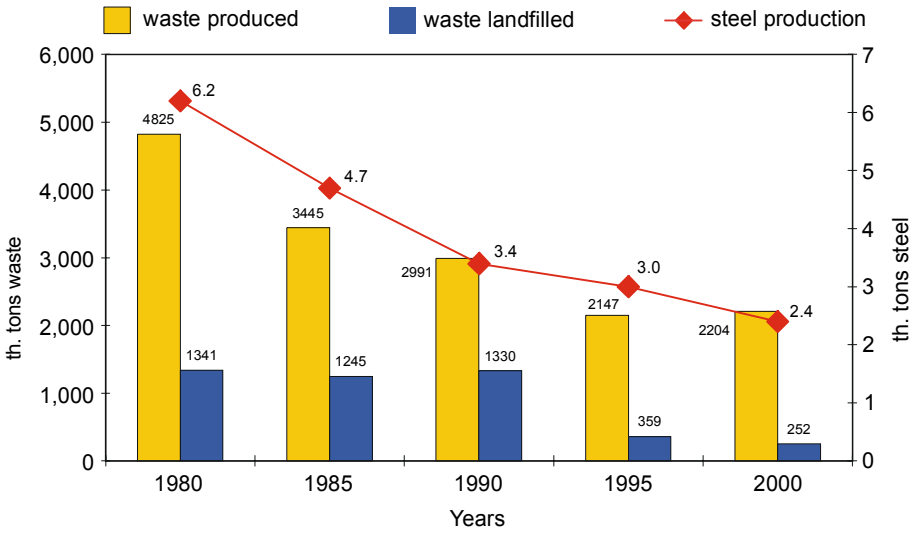


Figure 14. Waste management over the years.

Conclusions

Recently, a number of initiatives have been implemented in the field of environmental protection. The steel production impact on the local environment has been radically decreased. It is a result of interaction of the following factors:

- Production decrease by 2/3.
- Phasing out of the most hazardous installations (e.g. No. 1 the sinter plant, three blast furnaces, the open-hearth plant, etc.).

- Modernisation of the existing technological lines (e.g. two blast furnaces and sinter belts).
- Construction of modern production lines (e.g. a coke oven battery with dry quenching of coke, an installation for continuous steel casting).
- Increasing dust removal efficiency and construction of high-efficiency dust collectors.
- Using low-sulphur materials and low-sulphur fuels.
- Closing of the water circulation and decrease in water consumption.
- Introduction of the selective waste disposal and increase of waste utilisation.

The following environmentally friendly activities are planned in the nearest future:

- Construction of the coal dust blowing devices (at the blast furnaces unit).
- Construction of a new installation for dust removal in the Bessemer mill.
- Installation of new high-efficiency filters in the thermoelectric plant.

Besides the investment activities, a number of environmental system solutions have been undertaken, including membership of the "Cleaner Production" programme. In 1997 the HTS was granted a "Cleaner Production" certificate.

The HTS has also developed and implemented the Environmental Management System according to the ISO 14001 standards. The Environmental Policy approved by the President of the Plant's Board constitutes a basis for the System. The whole staff is requested to support the activities aimed at the transformation of HTS into an environmentally friendly Plant. As a result of all the measures taken the environmental impact of HTS is significantly reduced (and will be even further reduced) for the benefit of the natural environment and the inhabitants of the Cracow Agglomeration.

"Organika-Azot" Chemical Plant in Jaworzno – Hot Spot No. 89

General description

The "Organika-Azot" Chemical Plant in Jaworzno is a medium size enterprise within the chemical industry.

According to the Standard Classification of Chemical Industry it complies with point 2.1: pesticide and other agrochemical production, and to a certain extent with point 2.3 production of pharmaceuticals, medical chemicals and botanical products (formulation of veterinary drugs).

Chemical Plant in Jaworzno has over 80 years of tradition and experience in the field of agrochemical production.

As late as the 1970s and 1980s, installations were operating for the synthesis of some biologically active substances used for the production of pesticides, including DDT, HCH and methoxychlor, as well as other chemical installations (*e.g.* the chloralkali unit) causing significant emissions of pollutants to the environment.

As a result, the water and ground environment of the Plant's area is polluted by pesticides, heavy metals (copper, zinc, mercury) and organic chlorinated hydrocarbons. Pollutants have been washed out into the surface waters.

In 1994 the "Organika-Azot" Chemical Plant state-owned company in Jaworzno was transformed into the joint-stock company. The restructuring program was initiated. It was decided that the production profile should include chemical synthesis, formulation and manufacturing of pesticides based on purchased concentrates of biologically active substances, formulation and manufacturing of hygienic preparations and veterinary drugs.

The present production profile focuses on:

- One installation for chemical synthesis – chlorfenwinvos (the organic phosphate insecticide (Birlen)) production.
- Four installations for the formulation of liquid preparations (insecticides, herbicides, fungicides, solutions for aerosols).
- Three installations for formulations of water suspension preparations (fungicides, herbicides and cereal pickles).
- One installation for filling aerosol diffusers.

Total production volume in 2000 – about 1,800 tons, equivalent to 928 tons of biologically active substances.

Water and wastewater management

Efforts have been undertaken to implement the best available technologies in the production processes as well as HELCOM Recommendations 14/2 and 23/11.

The amounts of wastewater and pollutants discharged to the surface water have been significantly reduced over the years. This is partly a result of the decrease in production levels due to fall in the market demand, but it is also an effect of the protection and remedial measures taken.

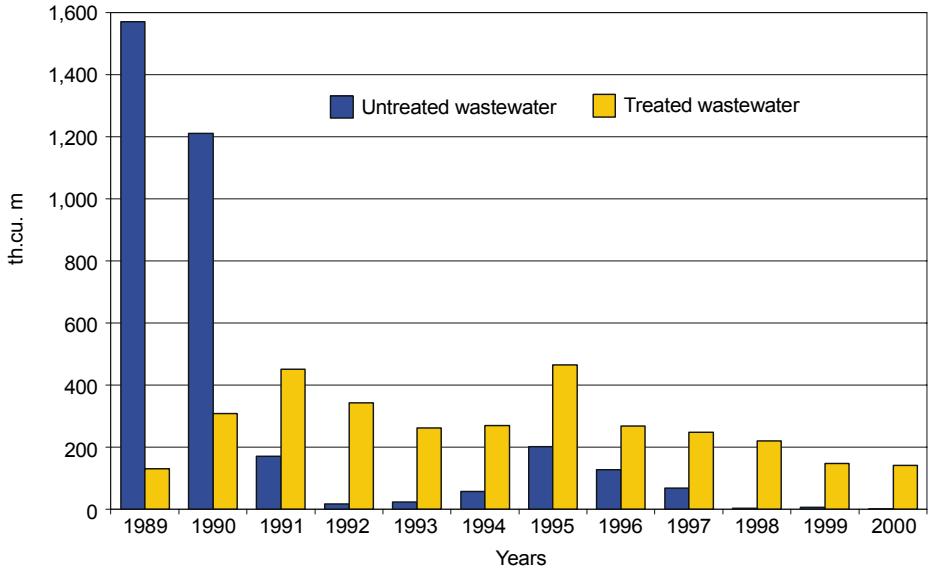


Figure 15. Annual volume of wastewater discharged over the years.

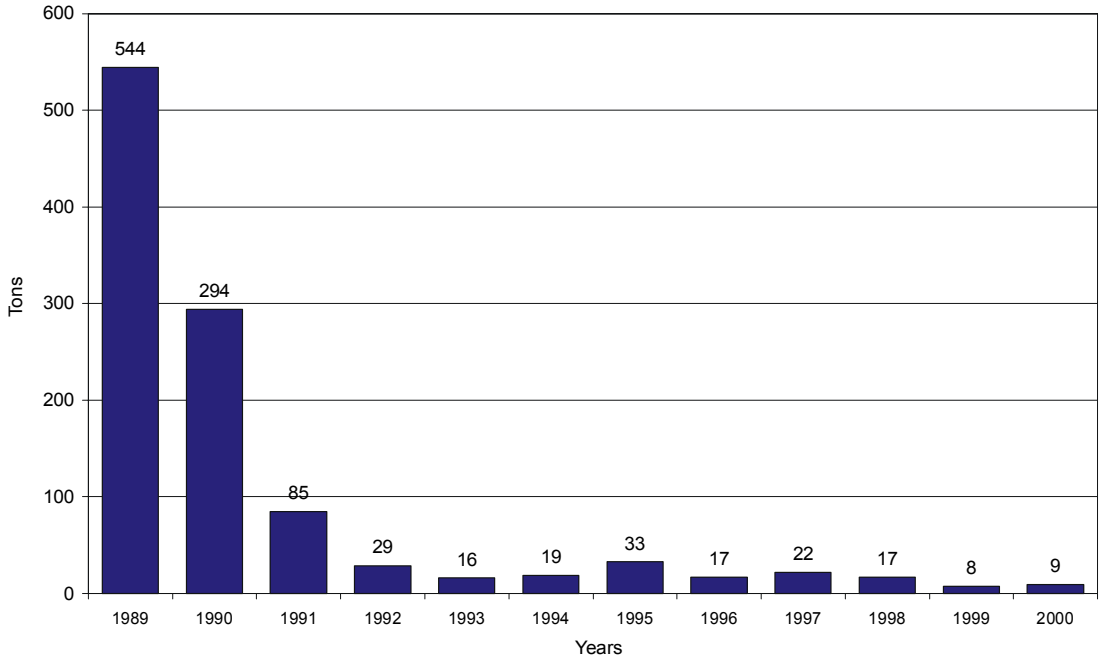


Figure 16. Annual load of COD discharged to the recipient over the years.

Table 25. Average concentration of pollution in treated wastewater (1st half 2001) in comparison with national requirements and HELCOM Recommendation 23/11.

Parameters	Concentration [mg/l]		
	Reached by the plant	Required by	
		national legislation	HELCOM
COD	122.9	150	250
TOC	23.1	40	80
AOX	7.06		1
P-tot	0.85	5.0	2
N-tot	4.12	30.0	50
Cu	0.239	0.5	0.5
Zn	0.153	2.0	2.0
Hg	0.001	0.02	0.05
CN^-_{vol}	0.04	0.1	
CN^-_{bound}	n.d.	5.0	
Phenols	0.231	0.5	
Chlororganic insecticides		0.5 μg/l	
DDT	8.48 μg/l		
HCH (α+β+γ)	157.4 μg/l		
DMDT	10.3 μg/l		
Phosphoorganic insecticides		10.0 μg/l	
Chlorfenwinvos	697 μg/l		
Fenitrothion	21.6 μg/l		

n.d. – not detected

Concentrations of the organic compounds, nutrients and heavy metals comply with the national standards as well as the HELCOM Recommendations.

Pollution expressed as AOX concentration determined by an analytic method using CADAS 200 spectrophotometer and Dr Lange cuvette tests, exceeds the limit value several times.

Pesticide pollutant concentrations, including DDT (one of the persistent hazardous organic substances) exceed the national standards for sewage discharged to the groundwater. It should be underlined that this is mainly the result of past manufacturing activities, which caused pollution of the Plant's area, rather than the present technology. The other reason is a partly unsealed waste dumping site.

Generation of vacuum in the installation for chlorfenwinvos synthesis would require a change in technology to a sewage-free one, as it can result in chlorfenwinvos presence in wastewater. The future of chlorfenwinvos production, executed for the BASF concern, is unknown, and so a decision on the change in technology cannot be taken.

Since 1996 efforts have been made to modernise the Plant's sewage treatment plant. The most crucial goal is reduction of the pesticide residue concentrations in sewage to the level required by the national standards.

Taking into account high cost of discharging sewage to the municipal treatment plant for further treatment, it was decided that this significant problem should be solved on the spot. The co-operation with scientific institutes and specialised firms has been established.

Emission to the atmosphere

Table 26. Annual dust emission (<10 µm).

	Emission in 2001 [t]	**Limit according to permit for emission (national regulation) [t/year]**
Emission from energy production	0.8	2.072
Emission from pesticide production, including:	0.8	1.945
copper compounds (50 % Cu)	0.086	0.064
TOTAL	1.6	4.017

Table 27. Annual gas emission.

	Emission in 2001 [t]	**Limit according to permit for emission (national regulation) [t/year]**
Emission from energy production		
CO_2	361.35	
SO_2	0.52	
NO_x	1.10	
Emission from pesticide production		
Chlorine	0.004	0.048
Hydrogen chloride	0.308	1.500
Aliphatic hydrocarbons	1.772	8.473
Xylene	0.054	0.092
Dichlorvos	0.00155	0.0024
Other aromatic hydrocarbons	0.047	0.059

The 5 mg/Nm^3 limit for dust emission when the mass flux is equal to or exceeds 25 g/h, according to HELCOM Recommendation 23/9 has not been exceeded, with the exception for one emitter in the installation for formulation of water suspension preparations.

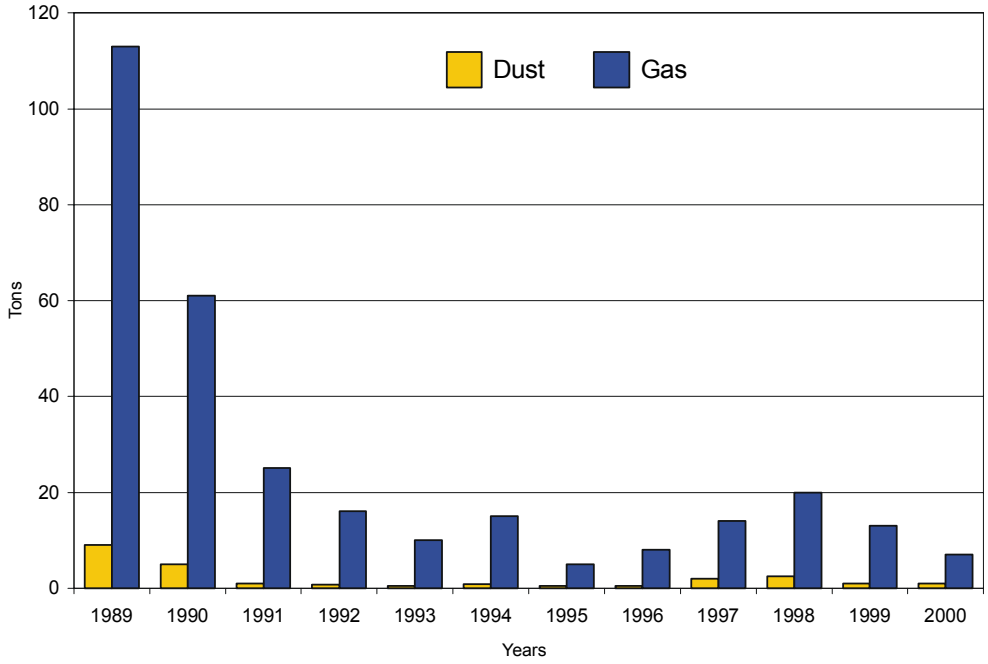


Figure 17. Emission of pollution to the atmosphere over the years.

Activities aimed at reduction of pollution and the results obtained

Since 1990 the following measures have been undertaken:

- In 1990 the installation for mercury electrolysis of potassium chloride and lye boilers (potassium production) were closed as they were deemed hazardous to human health and the environment; in 1991 chloral and methoxychlor installation and in 1992 acaritox and arylphosphates were closed.
- The installation for formulation of suspension dust preparations was modernised.
- In 1990 the chemical and mechanical sewage treatment plant was put into operation; the Plant's sewerage system was modernised and all sewage from the plant's area was directed to a sewage treatment plant. In December 1994 after the girdling ditch around the plant's waste dump and sewage pumping-station had been built, the leakage was also directed to the sewage treatment plant. As a result, the amount of untreated sewage discharged into the surface waters has been reduced.
- In 1990 two ferroconcrete tanks for storage of hazardous waste were put into operation.
- The piezometric network was built around the plant's waste dump (in 1991, completed in 1998); the Plant has also started monitoring of the quality of quaternary groundwater so enabling an assessment of the influence of the waste deposited in the unsealed area on the status of the water.
- In 1995-1996 the modernisation project of plant's water management was elaborated and executed, the cooling water circuit was closed.
- In 1996-1998 the technology of chlorfenwinvos production was modernised, acetyl chloride was replaced by di-chloroacethyl chloride, eliminating chlorine as a material for synthesis, pans and tray under the storage containers and the reactor were modernised.

- In 1996-1997 the plant's boiler room for process steam, fired by the Ekoterm type oil fuel was built. That installation replaced the old coal-fired Jaworzno I heat and power generating plant, thus contributing to the reduction of boiler flue gas emissions.
- In 1997 the production of copper oxychloride (a biologically active substance used for fungicide production) was stopped. The copper, chlorides, sulphates discharges to the air have been reduced.
- In 1989-1991 the installation for solid waste (mainly packages) disposal by incineration was built. However, in spite of modernisation, it was still hazardous to the environment and human health. Therefore it was closed down in 1999. Packages are disposed to external receivers for incineration.
- Liquid chloride store was closed as it was not protected against operational accidents.
- In 1999-2000 two new installations were built and put into operation in 2001: one installation for formulation and manufacturing of Copper Extra 350 SC and one installation for formulation and manufacturing of liquid preparations. The installations are sewage-free, equipped with environmental protection facilities so a drop in the pesticide concentrates load in sewage is expected.

Total ecological effect, in comparison to 1989:

- 93.1 % reduction of air emissions;
- 91.6 % reduction of wastewater volume discharged;
- 98.3 % reduction of COD load;
- 85.4 % reduction of waste disposal;

Investment financing

Environmental investments costs in 1990-2000 came to approx. EUR 1.5 million. The most important sources were:

- Provincial Fund for Environmental Protection and Water Management – subvention in 1993 of EUR 12,500 (0.9 %).
- Provincial Fund for Environmental Protection and Water Management – loan in 1998 of EUR 70,600 (4.9 %).
- Plant's own resources – EUR 1.371 million (94.3 %).

As shown above, the investments were financed mainly from own financial resources. Difficult financial situation and arrears in environmental charges in the mid-1990s made getting financial support impossible.

Conclusions

In January 1990 the "Azot-Organika" Chemical Plant was listed on the national list of the most hazardous plants to the environment, the "List of 80". The main reasons for it were: non-regulated water supply and sewage disposal, hazardous waste management situation - environmental nuisance of the unsealed hazardous waste disposal site.

A programme of remedial measures was developed, which after verification in the mid-1990s, has been implemented.

Not all the requirements of national law and the HELCOM Recommendations have been met. Wastewater treatment is planned to be improved in 2003. However, the waste dumps operated in the past will remain a matter of concern. Further consideration is needed how to solve the problem of pesticide residues in the water and soil within the Plant's area.

"Szczecin – Skolwin" Paper Mill – Hot Spot No. 98.2

General description

The "Szczecin-Skolwin" Paper Mill was established in 1991 as a result of the transformation of state-owned "Szczecinskie" Paper Plant "Skolwin" into a sole shareholder company of the State Treasury. In 1996 the company became a joint-stock company.

The beginnings of the paper factory at Skolwin go back to 1886 when building work was commenced in the marginal stream valley of the Odra River, on the wetlands situated north of Szczecin. The completion of the erection of the paper factory took place simultaneously with the outbreak of the first world war in 1914. The mill near Szczecin was built by Schlesische Sulfit-Cellulose Fabrik Feldmühle, one of the biggest paper concerns in Germany. Along with the factory, housing estates for workers were built, and in time they became a part of the city.

The factory, localised by the Odra River, has its own 400-meter-long quay (called "FANT"), which on the one hand facilitates the supply of raw materials (timber, cellulose, coal) and the dispatch of paper by water, both to the Polish market and abroad, and on the other hand simplifies the intake of water, which is necessary in significant amounts for the manufacture of paper. The company owns 114 ha of land, which is largely unused and therefore may be built-up with new facilities connected with the modernisation of the paper-manufacturing machines.

The Mill also owns a railway siding connected to the Polish railway network. In future heat may be delivered to the northern districts of the city of Szczecin by the heat and power generating plant owned by the factory.

The basic areas of the company activity include:

- manufacture of newsprint and offset paper (45-65 g/m^2) for the Polish and foreign markets;
- manufacture of packing and coating paper;
- manufacture of wood pulp as a semi-product for the manufacture of newsprint and offset paper;
- generation of steam for processes and heating;
- generation of electric power supplementing the power purchased on the market.

Manufacturing profile

Newsprint and packing paper are two basic products offered by the factory. For the manufacture of the paper, the plant uses a combination of raw materials including wood pulp and chemical paper-pulp. Wood pulp (mainly from spruce) is manufactured at the factory pulp mill in which timber is ground. Chemical paper-pulp is purchased from external suppliers.
Chemical paper-pulp is only diluted in a hydropulper with a small amount of kaolin (approx. 5 %) in order for it to reach the required quality.

Environment protection at the "Szczecin – Skolwin" Paper Mill

The factory has its own biological treatment plant for treatment of municipal and industrial wastewater in the amount of 12,000 m^3/day, including:
10,000 m^3 of industrial wastewater produced by the Mill and
2,000 m^3 of municipal sewage from the city of Szczecin.

The start-up of the effluent treatment plant made it possible to meet the EU requirements pertaining to the parameters of effluents discharged. Effluents are treated in two stages.

Table 28. Average concentration of pollution in treated wastewater and specific load of pollution (2nd quarter of 2002) in comparison with BAT recommendation.

Parameter	Concentration [mg/l]	Specific load [kg/t paper produced]	
		Reached by the plant	BAT range
BOD_5	10.56	0.22	0.4–0.8
COD – Cr	56.83	1.17	1.5–4
Suspended matter	7.46	0.15	0.3–2
N-tot	7.92		
P-tot	0.35		

Environment protection investment projects

The erection of a biological effluent treatment plant in 2001 resulted in an effective limitation of environmental impact of the manufacturing activity, and especially in a decrease in the amount of loads discharged to surface water. The investment project cost approx. EUR 3.45 million – an amount paid owing to a credit granted by the Provincial Fund for Environmental Protection and Water Management and by the Paper Factory itself.

Along with the maintenance of the required technical condition of devices, further investment plans of the Plant also focus on the environment protection. At the moment the erection of a waste paper de-inking unit is in progress. The capacity of the unit will be approx. 250 t of waste paper/day, which will make it possible for the Mill to close the pulp unit which consumes significant amounts of energy and will significantly limit or eliminate the need to purchase cellulose. In this way newsprint will be manufactured from recycled material (mainly newspapers and magazines). The use of de-inked pulp for the manufacture of newsprint will improve the profitability of the manufacture of this type of paper by the mill through:

- the use of recycled paper for the manufacture of paper;
- a significant decrease in the consumption of electric power through the elimination of a pulp unit which consumes very high amounts of energy;
- an improvement in the quality of the paper manufactured.

Conclusions

HELCOM Recommendations 16/4 and 17/8 directed to the paper industry largely apply to the manufacture of chemical pulp. In keeping with its manufacturing profile, "Szczecin-Skolwin" Paper Mill uses a combination of raw materials for the manufacture of paper, including wood pulp and chemical paper-pulp (cellulose). Wood pulp is manufactured by the factory, while the chemical pulp is

purchased from external suppliers, so the Mill should not be considered as covered by above mentioned recommendations. Additionally, the factory meets all the conditions in the scope of the Best Available Technologies.

"Rokita" Chemical Plant in Brzeg Dolny – Hot Spot No. 104

General description

"Rokita" Chemical Plant in Brzeg Dolny is situated by the Odra River (at the 283rd kilometre of the river length), 38 km from Wroclaw. The plant premises cover 249 ha.

"Rokita" consists of four units used for manufacture and sales-related activity:

- Chlorine Unit;
- Rokopole Unit;
- Surface Active Agents Unit.
- Specialised Chemicals Unit;

where a wide range of products for various sectors, including chemical, metal, energy, pulp and paper industries, is manufactured:

- organic and inorganic chemicals;
- plant protection products;
- chemical additives;
- surface active agents;
- acrylic polymers;
- tanning and dispersing agents;
- emulsifiers;
- phosphoorganic compounds;
- household chemical products;
- polishing agents;
- resins;
- technical gases.

Environment protection at "Rokita"

The Plant is one of the most important chemical manufacturers using big variety of technologies with differentiated impact on the environment. The Plant's management is aware of that fact, therefore constant reduction of the adverse impact is a part of the development strategy.

The Environmental Strategy of "Rokita" was elaborated within:

- 1st Environment Protection Program for the years 1988-1994;
- 2nd Environment Protection Program for the years 1995-1999;
- Development Strategy until 2001.

Environmental investments completed between 1968 and 1998 resulted in significant effects:

- 11-fold reduction of dust emission;
- 6-fold reduction of gas pollution emission;
- 35 % reduction of water consumption;

- 53 % reduction of the amount of wastewater discharged;
- 80 % reduction of COD load discharged to the recipient;
- 99.5 % reduction of phenols load discharged to the recipient;
- 57 % reduction of the solid waste production.

Water and wastewater management

"Rokita" has a two-stage wastewater treatment plant with the capacity of 33,000 m^3/d. Stage one is based on mechanical treatment plant equipped with sedimentation and equilisation tanks, a screen, a grit chamber, preliminary sedimentation tanks, emergency discharge tanks, preliminary aeration tanks, a turbo-blower station, secondary settlement tanks, a sludge dewatering station and a pH correction station. Second stage (currently under modernisation) involves biological treatment consisting of wastewater pumping station, a media station, activated sludge chambers, blower stations, Dorr secondary settlement tanks and recirculated and surplus sludge pumping stations.

Wastewater from all the technological processes is directed to WWTP. The outflow parameters do not exceed the limit values set in the national legislation. HELCOM requirements are met as well.

A reduction in the amount of wastewater was possible mainly owing to more economic water and wastewater management and an increased discipline at the individual manufacturing units. Very important was also closing of several phenol, betanaphthol, sorbite, trichloroethylene and chloroacetic acid manufacturing plants. The decrease in the load in the last decade resulted primarily from an increased effectiveness of the wastewater treatment process at the company wastewater treatment plant. Additionally, a few years ago the company implemented an automatic wastewater monitoring system measuring the volume of wastewater, pH and concentration of chlorides and TOC for most manufacturing plants. The system facilitates a fast reaction of the appropriate services in the event of an emergency wastewater discharge or other detected irregularities and additionally disciplines the manufacturing plants controlled.

Table 29. Average concentration and specific load of pollution (2001) in comparison to limit values set in HELCOM Recommendation 6/3.

	Reached by the plant	Required by HELCOM
Amount of mercury in the water discharged by the plant	0.393 g/t of chlorine production capacity	1 g/t of chlorine production capacity
Losses in the ventilation air	1.618 g/t of chlorine production capacity	2 g/t of chlorine production capacity
Annual average concentration of mercury in alkalis	0.16 mg/l	0.3 mg/l
Monthly average amount of mercury in the gas hydrogen	0.0013 g/t of chlorine manufactured	0.2 g/t chlorine manufactured

Table 30. Average concentration of pollution in treated wastewater (2001) in comparison with limit values set in HELCOM Recommendation 23/11.

Parameters	Concentration [mg/l]	
	Reached by the plant	Required by HELCOM
COD	367	250.0
N-tot	9.19	50.0
P-tot	1.6	2.0
Hg	0.006	0.05
Cd	0.002	0.2
Cu	0.017	0.5
Ni	0.036	1.0
Pb	0.020	0.5
Cr-tot	0.113	0.5
Cr-VI	—	0.1
Zn	0.2	2.0

Emission to the atmosphere

In recent years most of the production units have been modernised. This resulted in the significant decrease of gas and dust emission. In 2001 "Rokita" emitted 183 tons of atmospheric pollutants from manufacturing processes. The present emission level does not exceed permitted limit values. The reduction was achieved mainly through environmental investments, especially those carried out between 1988 and 1998, which resulted in:

- 11-fold reduction of dust emission;
- 6-fold reduction of gas pollution emission.

Waste management

"Rokita" produces approx. 70,000 tons of waste a year, including 9,000 tons of hazardous waste. Waste management is done in accordance with the national and EU law. The priority is given to handling and recycling. The waste which cannot be used is rendered harmless through disposal at a landfill site.

Environmental investment

Reduction of the impact on the environment was achieved through a number of costly investments. Implementation of the 1st and 2nd Environment Protection Programs required mobilisation of more than EUR 17.5 million and included:

- Modernisation and development of landfill sites for chemical and furnace wastes.
- Construction of a container and tank washing stand together with wastewater equalisation unit.
- Completion of the construction of an automatic system for industrial wastewater monitoring.
- Construction of the first stage of a biological WWTP.

In 1998 "Rokita" joined the group of enterprises engaged in the implementation of "Responsible Care" Program, where chemical industries make public commitments to improve their activities in the main areas of:

- environment protection,

- health protection,
- operational safety,

to couple high product quality with reduction of the emission of pollutants.

Within the program, the "Rokita" Chemical Plant decided to undertake the following measures:

- implementation and constant improvement of the wastewater monitoring system;
- modernisation and reconstruction of the wastewater treatment plant;
- modernisation of landfill sites aimed at improvement of safety conditions;
- constant modernisation of technologies resulting in reduced emission of pollutants and increased operational safety.

Conclusions

Measures aimed at the reduction of pollution, especially the load discharged to surface water bodies, have been taken for a number of years now. Step-wise introduction of environmental policy is reflected in the increased discipline at individual production units. Very important was also closing of several phenol, betanaphthol, sorbite, TRI and chloroacetic acid manufacturing plants.

The plant meets the requirements specified in the HELCOM Recommendations. The only exceeded parameter is COD concentration. However, the limit value will be reached in the near future, as modernisation of WWTP will be completed soon. It is expected that treatment efficiency will satisfy all the national and international requirements.

According to the Certificate granted in 2001, the environmental management system is consistent with the ISO 14001 standard. With the certificates, “Rokita” joined a small group of Polish chemical industries managed with he highest standards required within the EU. This was possible only due to a long-term strategy of development, where environmental needs are seriously taken into account and supported by significant investments.

Measures undertaken within the Environment Protection Programs resulted in implementation of HELCOM Recommendation 23/6 aimed at reduction of mercury pollution form chloralkali industry achieved by:

- modernisation of the manufactured product purification;
- introduction of new filtering equipment (reduction of the mercury content in the effluent);
- modernisation of the WWTP.

HELCOM Recommendation 23/10 was implemented at the plant protection product manufacturing unit by:

- installation of a modern herbicide packing line;
- liquidation of historical landfill sites of chlorophenols followed by land reclamation;
- reduction of the pollution load by installation of a cyclone on the herbicide dedusting line.

Katowice Area – Hot Spots Nos. 88.5, 88.6, 88.7, 88.8

Industrial enterprises located in the Katowice area undergo substantial transformation in the recent years. Market economy results often in the elimination of the outdated, inefficient enterprises. Deep restructuring processes and changes in the ownership status require also improvement in the management of the wastes generated by those enterprises. Market economy resulted, in some cases, in reduction of industrial activities or in closing down the whole enterprises. Effectively enforced system of fees and fines for trespassing emission limits results in modernisation and improvement in the waste (including wastewater and air pollution) management.

Table 31. Industrial production in the Silesian Province.

Type of production	Percentage of the gross national production	Annual production
Raw steel	65	5,770 thousand tons
Rolled products	59	4,095 thousand tons
Electricity	21	2,857 GWh
Hard coal	90.5	100.8 million tons
Coke	65	5.5 million tons

Trends in the levels of environmental pollution in the Region for the period 1995 – 1999 are given in Table 32.

Table 32. Indices of environmental pollution in the years 1995 and 1999.

Parameter	Year 1995	Year 1999
Industrial and municipal waste water untreated per 1 km^2 in thousands of m^3	10.2	5.3
Population served by waste water treatment plants in % of total population	53.1	59.5
Emission of industrial air pollutants per 1 km^2 of total area in tons (from enterprises particularly susceptible to polluting the air)		
Particulates	7.7	3.5
Gases (excluding carbon dioxide)	60.7	48.0
Waste generated during the year per km^2 in tons (excluding municipal waste)	9,568*	3,989

* different borders of the Province

"Duo-Stal" Ltd. in Bytom – Hot Spot No. 88.5

In the "Duo-Stal" metallurgical plant there are two open-hearth furnaces and seven soaking pits (heated by natural gas), currently in operation. Adverse environmental impact of this plant results mainly from excessive gaseous and particulate emissions to the atmosphere, especially from the steelworks.

Decrease in the atmospheric lead emission from the open-hearth furnaces has been achieved by the reduced use of lead containing charge. The company plans to modernise steelworks and to replace the open-hearth furnaces with electric arc furnaces. Gaseous emissions (mainly nitrogen oxides) reached 285 tons in 1999; emission of the particulate matter was about 15 tons.

"Katowice" Steel Plant in Dabrowa Gornicza – Hot Spot No. 88.6

The "Katowice" Steel Plant, located on the Bobrek river in the Vistula catchment area, remains on the "List of 80" mainly due to gaseous and particulate emissions from the sinter division. In the sinter division, electro-filters on the number three and number one sinter strands have already been modernised. Modernisation is anticipated of the two electro-filters on the number two sinter strand, together with modification of the sintering process.

A local heat and power generating plant also requires modernisation. Among others, modernisation of power boilers is planned by installing burners with low emission of nitrogen oxides.

There are still problems with excessive dispersed emissions from casting houses in the Great Furnaces Division. Up till now, de-dusting installation was modernised in the casting house of the number 1 and 3 Great Furnace. The de-dusting installation in the house of the number two Great Furnace awaits modernisation. Metallurgical slag from the plant and the power generation wastes are disposed on the "Lipowka" dumping site.

To improve the waste management, the steel plant acts to increase the use of metallurgical slag in the cement industry. Dusts and mud from de-dusting of the furnaces and technological lines are returned to the technological process.

With decreasing amounts of the generated wastes, the steel plant intends to reuse the eastern part of the "Lipowka" dumping site, re-cultivate the remaining part of the site, and finally to build a new leak-proof disposal site with mineral seals in the eastern part of "Lipowka".

According to the report of the Chief Inspectorate for Environmental Protection, total emission in 1999 of particulate matter was 4,200 tons/year. Gaseous emissions were 97,012 tons, with 6,054 tons of sulphur dioxide, 7,977 tons of nitrogen oxides, and 82,915 tons of carbon dioxide. Lead emission was 130 tons.

This is the situation until the problems of excessive particulate and gaseous emissions from the sinter plant, boiler house, de-dusting installations from the number 2 Great Furnace are solved and the waste management is improved.

"Czechowice" Refinery in Czechowice-Dziedzice – Hot Spot No. 88.7

The environmental impact of this enterprise results mainly from deposition of the postproduction wastes in unsealed sedimentation ponds, discharge of excessively polluted wastewater to the surface water and excessive atmospheric emissions of hydrocarbons.

Postproduction wastes are deposited in three unsealed sedimentation ponds. After tens of years of deposition, there are more than 120 thousand tons of wastes containing crude oil derivatives, mainly post refining tars, and wastes generated by the current activities of the treatment plant.

At present work is carried out to reduce noxiousness of the plant. However, final deconstruction and liquidation will be accomplished within 10 years. In the past years, more that 4 thousand tons of wastes containing residues from the production of the thallic oil were deposited directly on the ground. By mid-1998, the site was cleared, as wastes were used in the local oil boiler house. The ground must be re-cultivated.

Atmospheric emission of hydrocarbons comes through two exhaust chimneys from the vacuum generating system and from the fuel gas system.

In 1999, gaseous emission from the plant reached 1,795 tons, including 220 tons of hydrocarbons. As decided by the Silesian Governor, the plant was obliged to present a repair program to reduce emissions of hydrogen sulphide, aliphatic hydrocarbons and odorous substances.

Wastewater management in the plant should be further improved. The plant discharges to Biala river (Vistula catchment area). All the wastewater (production and sanitary wastewater) from refining divisions are treated in the central treatment plant. COD load discharged by the plant in 1999 was 224 tons.

"Przyjazn" Coking Plant in Dabrowa Gornicza – Hot Spot No. 88.8

Environmental problems yet to be solved by the plant include: excessive emission of particulate and gaseous pollutants from coke oven batteries and insufficiently treated coking wastewater discharged to receiving water.

In 1999, atmospheric emission from the plant included 252 tons of particulates and 4,051 tons of gaseous pollutants (1,343 tons of sulphur dioxide, 736 tons of nitrogen oxides, 1,838 tons of carbon monoxide, 4.1 tons of ammonia, 2.7 tons of benzene, 1.3 tons of phenol, and 1.68 ton of hydrogen cyanide).

The amount of wastewater reached 2,006,000 m^3, with loads of pollutants discharged to Bobrek river (in the Vistula catchment area), including 354 tons of COD, 140 tons of ammonia nitrogen, and 1,200 tons of sulphates.

Taking into consideration the planned 3rd phase of the wastewater treatment plant modernisation, the coking plant got a temporary permission to discharge wastewater with higher levels of ammonia nitrogen and salinity.

COASTAL LAGOONS

The JCP Hot Spots List includes five priority areas for special management related to coastal lagoons and wetlands. Two of the them are partially located in Poland and these are:

- Hot Spot No. 73: transboundary area of the Vistula Lagoon shared by Poland and Russian Federation, and
- Hot Spot No. 113: transboundary area of the Szczecinski Lagoon shared by Poland and Germany.

The reason for recognition of the Vistula Lagoon and the Szczecinski Lagoon as ones of the highest priority regions in the field of the Baltic Sea protection is high biodiversity of the wetlands and adjacent areas, and on the other hand the economic pressure and its environmental consequences which oblige to introduce interdisciplinary projects in the coastal area protection.

These specific hot spots are covered by Element 4 of the JCP which has been formulated as management programmes for coastal lagoons and wetlands. The long term goal of the programmes was to contribute to the environmental balance of the Baltic Sea through the elaboration and implementation of the *Integrated Coastal Zone Management (ICZM)* plans in the identified coastal areas in the Southeast Baltic Region.

The HELCOM PITF Working Group on Coastal Lagoons and Wetlands (HELCOM PITF MLW), created in 1993, was designated to co-ordinate the programme development and implementation. The leading role was performed by the World Wide Fund for Nature (WWF).

In 1993 the elaboration of the ICZM plans was started. The plans were prepared by the Area Task Teams consisting of all the relevant stakeholders acting in the given area. The ATTs were obliged to identify and consider all natural and anthropogenic factors and activities which influenced the task area. The objective of the plans was to:

- Identify critical problems with regard to environmental protection and the conflicts between environmental protection and different industries, as well as between individual industries.
- Identify mechanisms required for closer co-ordination of efforts in the field of environmental protection and economic development.
- Elaborate guidelines for the national, regional and local authorities with reference to sustainable and environmentally friendly development in coastal areas included in the plans.

The first version of the ICZM plans for the Vistula Lagoon and the Szczecinski Lagoon was prepared in 1995 by the Polish ATTs, in co-operation with the Russian and German side, respectively. In the years 1998-1999 the plans were revised and updated.

The fact which needs particular emphasis is the differentiation of the ICZM plans of the coastal areas in the individual regions. Each of these regions plays a different role in the economy of its country. The regions are strongly or less industrialised, have suffered from environmental degradation on a large or smaller scale and the threats and their consequences have been identified to different degrees. The Szczecinski Lagoon area and the Vistula Lagoon area are typical examples.

The Vistula Lagoon - Hot Spot No. 73

General characteristics

The Vistula Lagoon is the largest coastal reservoir of the Southern part of the Baltic Sea, separated from the Gdansk Bay with the Vistula Spit (about 100 km long). The lagoon constitutes the buffer zone protecting waters of the Gdansk Bay against the pollution discharged from the catchment area (municipal and industrial wastewater, agricultural run-off).

Table 33. Characteristics of the Vistula Lagoon.

Morphometric element	Unit	Poland	Russia	Total
Area	km^2	328.0	510.0	838.0
	%	39.2	60.8	100.0
Length	km	35.2	55.6	90.7
Maximum / average / minimum width	km	11.0 / 8.9 / 6.8	13.0 / 9.5 /-	-
Maximum / average depth	m	4.4 / 2.4	5.1 / 2.8	-
Coastal line length	km	111.0	159.0	270.0
Volume	km^3	0.8	1.5	2.3

The lagoon catchment area occupies 23,871 km^2 within Poland and Russia which is about thirty times larger than the surface area of the Lagoon. It is created mainly by the river basins of Pregola, Mamonovka and Prokhladnaya rivers on the Russian side, and by the river basins of Pasleka, Bauda, Elblag rivers and the delta arms of the Vistula: Nogat, Szkarpawa and Kroleviec Vistula on the Polish side. The Pregola contributes to the inflow the most – about 62 % of freshwater. The Vistula Lagoon joins the Baltic Sea through the Pilawska Strait which goes across the Vistula Spit on the Russian side.

In the Polish part of the Vistula Lagoon coastal area two landscape parks are located: ”The Vistula Spit” and ”The Elblag Plateau”, as well as the Druzno Lake Reserve, one of the largest sanctuaries of freshwater birds in Poland.

Pollution discharged and Vistula Lagoon water quality

Monitoring of the Vistula Lagoon water is conducted on the basis of samples taken from the surface layer in ten measurement points during vegetative season, from April to November.

Four mechanical-biological wastewater treatment plants discharge wastewater directly to the Vistula Lagoon. The major pollution load flows to the lagoon via rivers.

Table 34. Pollution load discharged to the Vistula Lagoon from the wastewater treatment plants located on the Polish side of the coastal area in 2001.

WWTP localisation	Wastewater capacity [m^3/year]	Pollution load [ton/year]				
		BOD_5	COD-Cr	Suspended matter	N-tot	P-tot
Tolkmicko	271,000	5.6	20.3	4.0	2.2	1.5
Frombork	330,325	1.5	9.6	1.8	13.5	0.8
Krynica Morska	240,000	5.4	81.3	6.9	10.9	0.7
Piaski	25,000	1.9	5.9	0.8	2.1	0.3
Total:	866,325	14.4	117.1	13.5	28.7	3.3

Table 35. Pollution load discharged to the Vistula Lagoon via rivers from the Polish territory in 2001.

Pollution load [ton/year]				
BOD_5	COD-Cr	Suspended matter	N-tot	P-tot
3,274.06	34,444.54	10,694.83	3,243.67	323.72

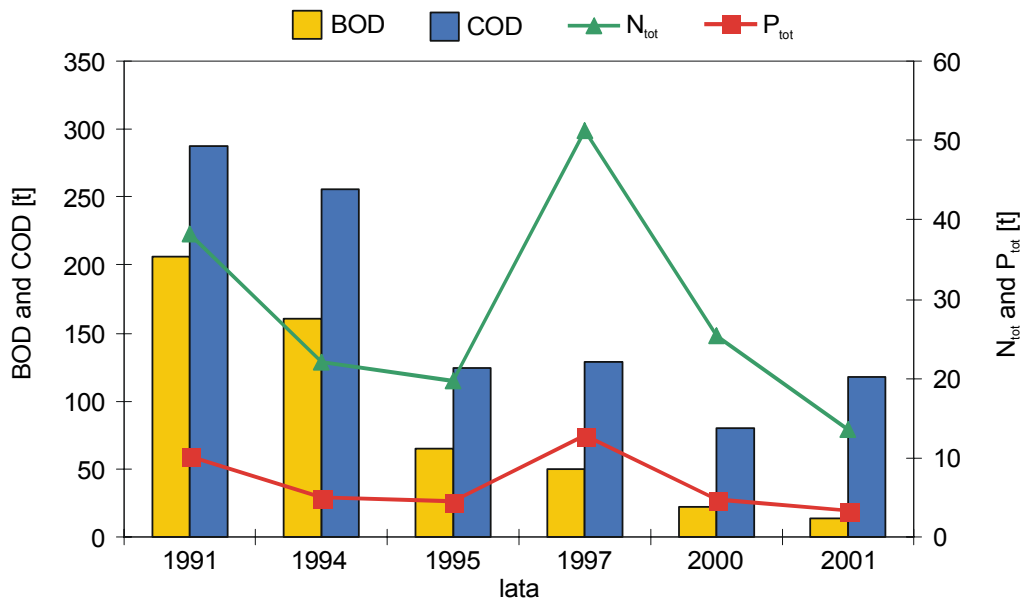


Figure 18. Pollution load discharged to the Vistula Lagoon from the point sources located on the Polish side of the coastal area in the years 1991-2001.

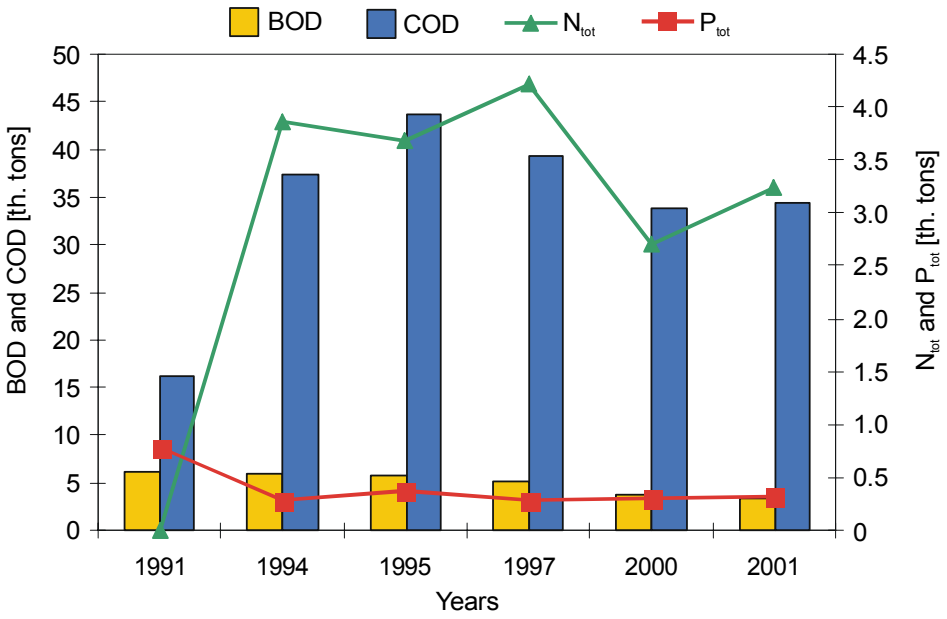


Figure 19. Pollution load discharged to the Vistula Lagoon via rivers from the Polish territory in the years 1991-2001.

Small depth of the reservoir and limited water exchange with the Baltic Sea results in susceptibility of the lagoon to eutrophication. The indicator which reflects intensity of phytoplancton blooms is chlorophyll-a. Very high chlorophyll-a concentrations in the lagoon water occur for years and range from 58 mg/m^3 in 1994 to 43 mg/m^3 in 2001.

Table 36. Vistula Lagoon water parameters in 2001.

Parameter	Range of values
Dissolved oxygen	7.5 – 28.5 mg O_2/l
Nitrogen in nitrates	0.9 – 4.49 mg N/l
Phosphates	0.13 – 0.53 mg PO_4/l
BOD_5	1.1 – 11.8 mg O_2/l
COD-Mn	10.5 – 30.8 mg O_2/l
COD-Cr	36.3 – 70.1 mg O_2/l

Sanitary conditions of the Vistula Lagoon water have systematically been improving since 1997. Single outcomes in 2001 broke this positive tendency (6 % of the total coli titre determinations confirmed the 3rd class of water purity of inland surface water classification). The last time values of coli titre corresponding to the 3rd purity class occurred in 1997 (17 % of determinations confirmed the 3rd class).

Concentration of toxic substances (heavy metals, chlororganic pesticides) in the Vistula Lagoon water is measured every year. Since 1999 slow increase of DDT concentration in water has been observed.

Table 37. Concentration range of monitored toxic substances in the Vistula Lagoon water in 2001.

	Indicator		Minimum	Maximum
1.	Zinc	mg/l	0.002	0.005
2.	Nickel	mg/l	< 0.005	
3.	Cadmium	mg/l	< 0.0001	
4.	Lead	mg/l	< 0.001	
5.	Copper	mg/l	0.002	0.006
6.	DDT	µg/l	0.004	0.007
7.	DDE	µg/l	<0.002	0.009
8.	DDD	µg/l	<0.003	0.007
9.	γ-HCH (Lindane)	µg/l	<0.002	0.02
10.	DMDT (Methoxychlor)	µg/l	Not detected at any measurement point.	

Vistula Lagoon is characterised by the unfavourable natural features (large surface, small depth) resulting in an exceptional susceptibility of the reservoir to external factors. During the intense waving, bottom sediment is raised, water transparency is decreased and pollutants deposited in the bottom sediments are again introduced to the ecosystem. Additionally, pollution load from rivers, diffuse sources and point sources contribute to a high level of lagoon fertilisation.

The assessment of the pollution reduction in the Lagoon is difficult due to complicated water mixing and exchanging processes which occur in the reservoir. A measurable effect of investments implemented so far is considerable improvement of the sanitary conditions of the Lagoon water.

Identification of problems and necessary actions

The largest city within the Vistula Lagoon drainage area is Kaliningrad (Russia). Other cities within the drainage area with population exceeding 100,000 inhabitants are Olsztyn and Elblag, both in Poland.

Wastewater management in most towns on the Polish side of the coastal area does not rouse major objections. All larger towns possess effectively operating wastewater treatment plants and sewerage systems connected to them. The major problem is the pollution load from the catchment area entering the Vistula Lagoon via rivers, resulting in the water eutrophication.

Conclusions from the "Prioritising hot spot remediation in the Vistula Lagoon catchment"[3] project show that around 75 % of the nitrogen load to the lagoon is coming from Russian sources, but only small improvements in the water quality are found in the Polish part of the lagoon when loads from the Russian hot spots are reduced. This is due to the limited water exchange with the sea.

Apart from eutrofication, another problem affecting the environment of the Vistula Lagoon area is an excessive concentration of tourist traffic, especially in relation to the protective forests and Vistula Spit dunes, which leads to the increasing deterioration of the Vistula Spit.

[3] DHI Water & Environment, Denmark, Geomor Co. Ltd, Poland, P.P. Shirshov Institute of Oceanography, Kaliningrad.

A permanent hazard in the Polish part of the Vistula Lagoon area are floods. The flood hazard is associated with a large share of depressions, the danger of flooding within polders, high water in major water courses, low efficiency of the existing anti-flood protection system.

The most important tasks aiming at the improvement of the Vistula Lagoon environment and people's safety include:

- Undertaking of measures aiming at the reduction of the pollution load discharged to the lagoon (direct discharges, discharges via rivers, pollution from the up-stream sources).
- Development of the technical infrastructure and mobilisation of financial resources.
- Promotion by tourist operators of natural attractions with some restrictions by rules and limits, as criteria for the selection of holiday sites.
- Ensuring the readiness and proper operation of drainage facilities (constant maintenance, repairs and service).

In order to improve the environment of the Vistula Lagoon area, a number of investments are implemented in the coastal communes.

The concept of integrated management in the Vistula Lagoon area is complicated due to the model of public administration composed of numerous elements. Integrated coastal zone management in the Polish part of the Vistula Lagoon involves terms of reference of the territorial self-government on three levels, two province governors and central bodies, which influence elaboration, implementation and monitoring of legal norms. The situation is still aggravated when the transboundary character of the Lagoon is considered, which entails the competence of two states: Poland and Russia.

The Szczecinski Lagoon – Hot Spot No. 113

General characteristics

The Szczecinski Lagoon, being part of the estuary of the Odra River, is a wide littoral reservoir. Its area is 687 km^2 and its average depth is 3.8 m. The reservoir is characterised by specific hydrochemical properties of waters which are formed under the influence of inland water inflow and water exchange with the Baltic Sea through the Pomeranian Bay. The volume of waters of the Szczecinski Lagoon is 2.58 km^3 and they are exchanged 6-7 times a year on average. Damming up of the waters which occurs in this area causes flooding of the coastal areas which are valuable habitats of flora and fauna and at the same time natural treatment systems for the pollution carried in by river tributaries and the area run-off.

The state border between Germany and Poland runs north to south and divides the reservoir into two parts: the western part, called the Small Lagoon and the eastern part, characterised by higher water exchange dynamics, called the Great Lagoon. The Great Lagoon covers the area of 410 km^2,which is about 60 % of the total lagoon area.

The main tributary of the Szczecinski Lagoon is the Odra River. The basin of this river covers about one third of the area of Poland (about 119,000 km^2). Other significant tributaries are the rivers:

Gowienica, Gunica, Dziwna, Swina, Piana, Swiniec, Wkra, Wolczenica and Zarow. The water from irrigation polders is discharged from the direct basin to the Lagoon.

The water outflows through three straits: through Swina and Dziwna into the Pomeranian Bay and through Piana into the Greifswald Lagoon. The biggest lake in the mouth of the Odra River is Lake Dabie which is directly connected with the Szczecinski Lagoon. The pollution and biogenic compounds discharged into Lake Dabie and coming mainly from the Szczecin agglomeration are a serious burden to the whole estuary of the Odra River.

In the area of the Wolin Island the Wolinski National Park exists, which represents an area of unique Pomeranian nature. By including the one-mile wide adjacent waters of the Baltic sea and the internal sea waters of the Szczecinski Lagoon the park became the first sea park in Poland. The park also obtained the BSPA (*Baltic Sea Protected Area*) status.

Szczecinski Lagoon water quality

The assessment of the pollutants discharged in the area of the estuary of the Odra River was made possible by the data of the balance of pollutants discharged into the Odra River, the Szczecinski Lagoon and the Pomeranian Bay, carried out in 1995 within the framework of the HELCOM PLC-3 programme. PLC-4 is now being prepared, which additionally includes the area pollution, mainly from agriculture.

The examinations that have been carried out allow of the following statements:

- The quality of the waters of the Szczecinski Lagoon remains under influence of fresh inland water and saltwater of the Pomeranian Bay. Average salinity of these waters is 1-2 ‰.
- The analysis of the many years' changes of the quality of the Odra River waters indicates a systematic improvement in the boundary area. The value of some indicators such as the concentration of organic compounds, suspended matter, phenols and chlorides is approaching the desired value. In the last few years an improvement in the sanitary condition of the waters and a slight decrease in the contents of biogenic compounds can be seen as well.
- The content of phosphorus compounds has decreased considerably. The concentration of mineral phosphorus compounds is a limiting factor for the eutrophisation and algae expansion.
- No significant industrial pollution has been discovered lately in the waters of the Szczecinski Lagoon.
- The waters of the Odra River are the main source of pollution in the Szczecinski Lagoon. The Odra River carries contamination flowing from the upper stretch of the river, from the Szczecin agglomeration (lack of sewage treatment plants) and from the "Police" Chemical Plant, located in the outlet into the Roztoka Odrzanska.
- The pollution accumulated in the bottom sediments of the Lagoon and the continuous inflow of pollution discharged from the tributaries influence the present state of the Lagoon waters. Sewage from Szczecin, Police and the "Police" Chemical Plant is discharged in the mouth of the Odra river. The estimation of the grade of pollution reduction that takes place in the Lagoon is a very difficult task due to complicated conditions of water exchange and mixing which exist here.

In spite of the situation, the natural and economic values of the area of the Lagoon and its surroundings satisfy the requirements of UNESCO to recognise it as a biosphere reserve.

Threats and actions

The Szczecinski Lagoon is of great importance to the region. It is a highly productive fishing ground (mostly roach, bream, perch and pike-perch). Through the Great Lagoon runs the waterway from Swinoujscie to Szczecin. Swinoujscie is one of the most popular holiday resorts and health-care resorts of the southern coast of the Baltic Sea and at the same time it is a sea harbour of international importance. Szczecin is the biggest city of the province. The biggest industry of the province is concentrated here (including the harbour and shipyard industry). It is also an important traffic junction of land and water transport. In Police one of the biggest chemical plants producing phosphatic fertilisers is located.

The coastal areas of the Szczecinski Lagoon have already been developing dynamically, among other things due to the location close to the European Union border, the attractiveness of this part of the Baltic coast for tourists and the developing co-operation with the western and northern neighbours.

In order to improve the wastewater management in the area of the Szczecinski Lagoon many investments have been implemented which have resulted in reducing the noxiousness of the pollution discharged from the described area in comparison to 1995. Municipal and industrial wastewater from the Szczecin contributes significantly to the pollution load discharged to the Szczecinski Lagoon from its surroundings.

The greatest problems affecting the environment of the Szczecinski Lagoon area are:

- Emission of pollution (from point and non-point sources).
- High eutrophication level of the Szczecinski Lagoon and the Odra River waters. The consequence of the eutrophisation of the waters of the Lagoon is change in the species composition of game-fish (the quantity of such fish as eel, pike and powan is decreasing while the quantity of roach, perch and pike perch is increasing).
- Threats to water resources by the excessive exploitation of water resources.
- Threats to earth surface by the improper solid waste management. 99.4 % of the produced waste and 99.6 % of the stored waste is the waste coming from the industrial plants located within the administrative borders of two communes: Police and Szczecin.
- Localisation in the area around the Szczecinski Lagoon of some specific toxic waste storage sites called grave-yards (concrete containers in which mostly overdue pesticides and empty packagings are stored).
- Lack of a proper prevention system against floods and droughts.
- Lack of a joint environmental protection programme with Mecklenburg – West Pomerania.
- Changes in the economic and political system of the country causing deep negative economic changes including the wealth of the inhabitants.
- Damage caused by the forces of the Russian Federation stationed in Poland (Swinoujscie).

Taking into account the identified functions and utilisation methods of natural resources, the ICZM Plan for the Szczecinski Lagoon advises the following directions of development:

- Preservation and development of the key branches of industry resulting in an increase of income of the inhabitants in the areas included in the Integrated Coastal Zone Management, in accordance with the eco-development principle. The conditions of economic growth stimulation are: investments for the benefit of modern, environmental friendly technologies, modernisation of the infrastructure for industrial production and reorganisation of the industrial processes management systems.
- Protection of the unique nature and landscape values through maintaining the present forms of protection in the Integrated Coastal Zone Management of the Szczecinski Lagoon area and creation of new forms.
- Integrated protection of water resources, being a particular value for the area of the Szczecinski Lagoon and a condition of preservation of the exceptional economic and natural values of the area.

The possibility of integration of efforts in the field of ICZM of the Szczecinski Lagoon depends strongly on the real co-operation with the neighbouring Mecklenburg – West Pomerania region. The cooperation carried out at many organisational levels is based on agreements at a state, province and commune level. Many institutions are responsible for its realisation, depending on the issues concerned.

AGRICULTURAL HOT SPOTS

Two agricultural Hot Spots located in Poland have been included in the JCP List:

- Hot Spot No. 95 – Agriculture and Livestock Farming / Agriculture Run-off Programme for the Vistula River Basin;
- Hot Spot No. 112 – Agriculture and Livestock Farming / Agriculture Run-off Programme for the Odra River Basin.

These two hot spots cover almost the whole Polish territory. Due to this they are not manageable and it is not possible to undertake any curative measures with measurable effects. Considering the idea of establishing the JCP Hot Spots as a list of locations having the largest negative impact on the Baltic Sea environment, one can come to a conclusion that there is no justification for such definition of the Polish agricultural hot spots. Poland has started work to identify smaller agricultural hot spots to be proposed as replacements for the two large size hot spots currently included in the Hot Spot List. This is in line with the PITF document adopted in May 1999, "Criteria for inclusion and deletion of hot spots: Procedures and guidelines for inclusion and deletion of hot spots". This document proposes to "divide existing large hot spots, of all types, to make them more manageable and operational when consistent with the objectives of the JCP".

The Polish proposal with regard to this has not been fully discussed yet in HELCOM and work is being undertaken to finish the revision of the Polish agricultural hot spots.

POLISH HOT SPOTS DELETED FROM THE JCP LIST

This chapter presents the Hot Spots which have been deleted from the Programme List so far. Two of them were closed down and that was the reason for deletion (Nos. 81.2 and 98.3). Two other Hot Spots (Nos. 96 and 111) have been found not to have any negative impact on the Baltic Sea environment. The rest of the locations have been deleted thanks to a considerable improvement of the situation and compliance with the environmental standards.

The list of Polish Hot Spots deleted from the JCP List is presented in Attachment 1.

To date, 24 Polish locations have been removed:

- Hot Spots Nos. 81.2, 98.3 – deleted in 1996.
- Hot Spots Nos. 76.1, 80 – deleted in January 2001 according to the PITF decision.
- Hot Spot No. 105 – deleted in November 2001 according to a decision of the 18th Meeting of PITF.
- Hot Spots Nos. 75, 77, 78, 79, 90, 91, 92, 96, 99.1, 111 – deleted in May 2002 according to decisions taken by the 18th Meeting of PITF and the Fifth Meeting of HELCOM LAND.
- Hot Spots Nos. 76.2, 81.1, 83.2, 98.1, 101, 102.1, 102.2, 102.3, 106 – deleted in November 2002 according to the decisions taken by the Sixth Meeting of HELCOM LAND and the 19th Meeting of PITF.

"Debogorze" WWTP in Gdynia - Hot Spot No. 75

The "Debogorze" WWTP was built in the years 1961 – 1965 and up to 1993 it worked as a mechanical treatment plant only. In 1993, one biological line with a flowrate of 86,000 m^3/d was put into operation. Neither the volume of aeration tanks designed in the eighties, nor the processing equipment installed ensured the high capacity of nutrient removal. Additional work was undertaken to develop and modernise the plant to eliminate nutrients by adopting the Bardenpho system. In 1997, a new biological reactor of 46,000 m^3 capacity was put into operation.

Results of the implemented modernisation are (as of 2001):

- 3.7 mg/l and 99 % reduction of BOD_5;
- 20.8 mg/l and 73.1 % reduction of nitrogen;
- 0.83 mg/l and 93.3 % reduction of phosphorus.

The investment outlays on Plant's modernisation are approx. EUR 19.6 million.

"Wschod" Wastewater Treatment Plant in Gdansk - Hot Spot No. 76.1

Modernisation and extension of the "Wschod" WWTP was the biggest ecological investment in the region. WWTP processes wastewater originating from Gdansk, Sopot and the adjacent communes.

The plant's modernisation was finished in 1999. The designed capacity is 180,000 m^3/d. After the start-up the following treatment efficiency has been achieved:

- 3.2 – 7.7 mg/l of BOD_5;
- 7.3 – 9.8 mg/l of nitrogen;
- 0.7-2.7 mg/l of phosphorus.

The total cost of WWTP extension amounted to EUR 69.7 million (City Budget, credit from NFOSiGW and WFOSiGW, National Budget, EcoFund). Construction of a discharge system to the Gdansk Bay is planned for the years 1999-2002.

Gdansk Refinery – Hot Spot No. 76.2

General description

Gdansk Refinery is the biggest company in the Gdansk Coast and one of the biggest companies in Poland. It was established in 1972-1975. It is the youngest refinery in Poland and a modern company undergoing continuous development.

The refinery is located on the area of approximately 300 hectares, 70 % of which is covered by a park of tanks storing raw materials, semi-products and final products. The total capacity of all the tanks amounts to one million cubic meters. Owing to its hydrocracking unit, the refinery may boast a high complexity coefficient and a deepened conversion of crude oil processing. The plant manufactures both fuels and lubricating oils. It is connected with a crude oil pier of the Northern Port and the „Druzba" pipeline by a system of pipelines, which facilitates import and export of products and diversifies crude oil purchase options. The position of the Gdansk Refinery is best evidenced by its share in the domestic fuel market, which amounts to 16.4 % – and more than 39 % in the car engine oil market.

Production profile

The basic technological processes are grouped in three integrated units: fuel unit with the annual processing capacity of 4.5 million tons, oil unit with the production capacity of 250,000 tons of base oil and the hydrocracking unit built in 1999, with the annual processing capacity of 1.4 million tons. The oil unit of the Gdansk Refinery is one of the largest lubricating oil manufacturing centres in Europe.

Manufacturing and supplementary processes are controlled by a modern diffused TDC 3000 control system connected with a computer management support system.

The refinery manufactures not only petrol and diesel oils. After the opening of the hydrocracking unit, the range of products sold has been extended to include:

Diesel fuel	21.5%
petrol	25%
heavy furnace oil	22%
light heating oil	13%
aviation fuel	8%
base oil and manufactured oil, total	3%

asphalt	4.5%
liquid gas	1%
other products	2%

Environment protection at the Gdansk Refinery

Due to its business profile, the Refinery produces all types of pollutants. In order to achieve environmentally friendly goals, environmental policy is followed. It is co-ordinated under the Environmental Management System consistent with ISO 14001 and procedures facilitating full control over the environmental impact of the Plant and supporting its continuous limitation.

The environmental policy of the Refinery aims at the limitation of the emission of pollutants produced during manufacturing processes, a decrease in the use of technological services, thorough wastewater treatment and waste management.

Since 2000 the petrol manufactured at the Refinery contains no lead and the diesel oil has low sulphur content.

The radical decrease in the amount of pollutants emitted to the atmosphere during the last 10 years was possible due to the mobilisation of significant funds in modernisation of the existing systems and building of new ones.

Water and wastewater management

The Gdansk Refinery has a three-stage wastewater treatment plant treating the five types of wastewater produced in a mechanical, chemical and biological way:

- process wastewater – produced during the processing of crude oil and manufacture of kerosene products; undergoes mechanical, chemical and biological treatment;
- oil contaminated wastewater – from the park of tanks and production systems; undergoes mechanical, chemical and biological treatment;
- sanitary sewage - undergoes biological treatment;
- drainage waste - undergoes mechanical and chemical treatment;
- clean rainwater – undergoes mechanical treatment.

After treatment, wastewater is discharge to surface waters of the 2nd class of purity. Parameters of the wastewater discharged are consistent with the allowable values specified in the wastewater discharge permission issued by the Pomeranian Provincial Office.

Both the monitoring of the treatment process and analyses of the wastewater discharged to surface waters are carried out by the laboratory employees in accordance with the procedures in force. Samples of the treated wastewater are collected in accordance with the Polish Standard, and analyses are consistent with either Polish Standards or ISO standards.

The cooling systems used at the Refinery use closed water circulation. Cooling water is pumped to heat exchangers of production systems at the fuel unit and oil unit, where it collects the heat and returns to ventilation coolers to be cooled and returned to the circulation system. The system must be

supplemented with approx. 50,000 m^3 of water a month due to evaporation and exhaust of water from the ventilation coolers. Additionally, as a part of water and wastewater management rationalisation policy, approx. 44% of the wastewater produced and treated at the Refinery is used for industrial and internal purposes.

The average monthly contents of oil in the wastewater (analysed with IR spectroscopy) amounts to max. 2 mg/l, while the total discharge amounts on average to 1.98 g/ton of the raw material processed. The values do not exceed limits set in HELCOM Recommendation 23/8 (5 mg/l and 3 mg/ton, respectively).

Table 38. Average concentration of pollutants in discharged wastewater (2001) in comparison with limit values set in HELCOM Recommendation 23/11.

	Concentration [mg/l]	
	reached by the plant	**required by HELCOM**
COD	28.5 – 46.2	250
P-tot	0.17 – 0.62	2
N-tot	3.3 – 12.2	50

Table 39. Average concentration of heavy metals in treated wastewater (2001) in comparison with limit values set in HELCOM Recommendation 23/11.

	Concentration [mg/l]	
	reached by the plant	**required by HELCOM**
Hg	0.0002 – 0.005	0.05
Cd	≤0.001	0.2
Cu	0.0005 – 0.002	0.5
Ni	0.013 – 0.029	1
Pb	0.001 – 0.008	0.5
Cr-tot	0.005	0.5
Cr-VI	-	0.1
Zn	0.001 – 0.03	2

All the concentrations are well below the limit values established in HELCOM Recommendation 23/11.

Normally, wastewater is not analysed for AOX. However, in December 2000 the Refinery made a single analysis of the parameter and obtained the following results:

- for wastewater undergoing a three-stage treatment – 0.0816 mg/l;
- for wastewater undergoing mechanical and chemical treatment – 0.0619 mg/l.

The Refinery does not check the toxicity of the wastewater discharged after treatment to surface water, either. An analysis in this scope was carried out once, in December 2000 for wastewater treated with the help of mechanical and biological methods as well as mechanical, chemical and biological methods. An analysis of general toxicity was carried out in the Microtox system, using *Vibrio fisherii*

bacteria as bioindicator. On the basis of a preliminary 5-minute and a 15-minute test, the samples analysed were not found to be toxic.

Emission to the atmosphere

The total emission from the Gdansk Refinery in 2001 amounted to 8,053 tons of gas pollutants, including 5,506 tons of sulphur dioxide, 1,751 tons of nitric oxides, 751 tons of carbon monoxide, and 90 tons of dust. Despite a 1/3 increase in production, the level of sulphur dioxide emission to the atmosphere has remained at the same level.

Waste management

As far as waste management is concerned, the Gdansk Refinery follows the minimisation of the amount of waste produced. The waste generated is primarily provided to external parties for further industrial use or disposal. The waste which cannot be rationally used together with waste produced at the social part of the plant are rendered harmless through disposal at the landfill site.

In 2001 the Plant produced 13,891 tons of hazardous waste and waste other than hazardous, with 13,398 tons transferred for further industrial use or rendered harmless in a way other than disposal. Out of the remaining amount of waste rendered harmless through disposal, municipal waste constituted as much as 156 tons.

Conclusions

The Gdansk Refinery has fulfilled all the formal requirements in the scope of its environmental use management. All the permits issued (concerning the emission of pollutants to the atmosphere, water intake, sewage disposal and production of waste with temporary storage on the premises) are consistent with the Polish law in force. The Gdansk Refinery also meets all the environmental protection requirements in the scope provided in HELCOM Recommendations 23/8 and 23/11.

The modern world-standard production technologies and environmental protection systems used at the Gdansk Refinery effectively minimise the load of pollutants discharged both to the surface water and to the atmosphere. There is no doubt that the technologies meet the requirements of the Best Available Techniques.

The Gdansk Refinery has a system covering five types of sewerage, including separate systems for oiled wastewater and rainwater. All the wastewater from the premises of the Gdansk Refinery undergoes mechanical, chemical and biological or mechanical and chemical treatment, depending on the contents and production sources. The quality of wastewater discharged after treatment to surface waters meets all the criteria specified in the Polish permits, while concentration of pollutants is much below the admissible parameters determined both by the Polish law and the Helsinki Convention recommendations.

Frantschach Swiecie (Pulp and Paper Mill) - Hot Spot No. 77

Frantschach Swiecie is one of the biggest European pulp and paper companies. The company specialises in production of unbleached fiber and a wide range of corrugated casing materials and sack paper. Best Available Technology is applied as wood dry barking, four-stage pulp screening systems, three stage pulp washing system with a total washing recirculation, non-effluent pulp production

(almost all effluents are recycled), closed technological and transmission water circulation, three-stage effluents treatment system. No molecular chlorine in used in the Mill for pulp bleaching. In January 1999 production of sulphate, viscose and bleached pulp was permanently given up.

The ecological effects that the company achieved have been the following:

- Reduction of the fresh water consumption from the level of 126 thousand m^3/d in 1994 to 62.6 thousand m^3/d in 2000.
- Reduction of the COD load in the effluents discharged from the mill from the level of 36 t O_2/d to 5.2 t O_2/d in the same period.

All relevant HELCOM Recommendations are easily fulfilled. Within the last six years many investments with a total cost of USD 252 million were carried out in the mill (own resources); of this amount USD 74 million were spent on ecological projects.

"Fordon" WWTP in Bydgoszcz - Hot Spot No. 78

The plant construction was started in June 1997 and completed in October 2000. The final results of treatment efficiency were achieved in May 2001. The plant is designed as mechanical-biological one with additional nutrient removal with the capacity of 26,710 m^3/d.
Very good parameters of wastewater treatment have been achieved:

- 11 mg/l and 96 % reduction of BOD_5;
- 13 mg/l and 79 % reduction of nitrogen;
- 1.45 mg/l and 84 % reduction of phosphorus.

The total cost of the investment amounted to EUR 17.9 million (NFOSiGW, WFOSiGW, PHARE, City Budget).

"Kapusciska" WWTP in Bydgoszcz - Hot Spot No. 79

The "Kapusciska" WWTP processes municipal and industrial wastewater from the "Zachem" Chemical Plant in Bydgoszcz. Chemical wastewater constitutes 35 % of the inflow. The industrial and municipal wastewater streams are treated separately.

The technological start-up was completed in September 2001. The designed capacity is 71,880 m^3/d. The achieved treatment efficiency was as follows:

- 6 mg/l and 98.6 % reduction of BOD_5;
- 8.91 mg/l and 82.7 % reduction of nitrogen;
- 1.21 mg/l and 85.5 % reduction of phosphorus.

The total cost of the investment amounted to EUR 43.5 million (loans from NFOSiGW and WFOSiGW, credit from PeKaO S.A. Bank, subsidy from GFOSiGW, own resources).

WWTP in Torun - Hot Spot No. 80

Chemical and biological WWTP with a capacity of 90,000 m^3/d was finished in 1998. Additionally, programme of sludge utilisation was realised. The achieved wastewater treatment efficiency was as follows:

- 10.4 mg/l and 96.1 % reduction of BOD_5;
- 7.9 mg/l and 83.8 % reduction of nitrogen;
- 0.94 mg/l and 88.4 % reduction of phosphorus.

Total cost of the WWTP construction amounted to EUR 23.3 million. Total cost of the preparation for sludge utilisation is EUR 3.2 million. The sources of financing were: National Budget, NFOSiGW, WFOSiGW, GFOSiGW, Commune Budget.

"Anwil" Nitric Plants in Wloclawek - Hot Spot No. 81.1

General description

"Anwil" (formerly "Wloclawek" Nitric Plant) is one of the biggest enterprises in the region as well as one of the domestic leaders of the chemical industry. The Plant is located in Wloclawek, in the north-eastern part of the city, approx. 10 km from the centre. It is located at the national road no. 1 and the railway.

The Plant is a manufacturer of chemical products for the processing industry (PVC, granulated PVC products and PVC tiles, caustic soda and soda lye) and for agriculture (saltpetre, nitro-chalk). The high position of the plant on the national and international markets is mainly due to high quality of the products (ISO 9001 and 9002 certificates as well as Q quality sign for nitrate saltpetre).

The Environmental Management System consistent with ISO 14001 standard, which was introduced in 2001, enables the overall control of the production activities in relation to the impact on the environment. The Plant is also involved in the "Cleaner Production" Program which helps to introduce modern technologies together with the best possible use of human work, energy and materials.

Production profile

The main product of the Polyvinyl Chloride Unit is polyvinyl chloride produced under the licence of the Japanese "SHIN ETSU" company. Brine is the raw material used for the electrolysis, where chlorine is produced. Chlorine is synthesised with ethylene. Polyvinyl chloride is further polymerised giving the final product.

Nitrite saltpetre is the second most important product of the Plant. Based on the technology owned by the Kaltenbach company, natural gas is the raw material. In the reforming process with the water steam it is converted to hydrogen, further synthesised with nitrogen to ammonia and then nitric acid. The latter is neutralised with ammonia giving the ammonium nitrate (nitrate saltpetre), which is a base for the production of fertilisers.

Other chemical products, such as liquid ammonia, ammonia water, technical nitric acid, soda lye, granulated caustic soda, precipitated salt (NaCl), liquid chlorine, liquid nitrogen, liquid oxygen, hydrochloric acid, are also offered by the Plant.

Table 40. Production capacity and the actual production volume in 2001.

Product	Production capacity [t/year]	Volume of production [t/year]
PVC	200,000	189,950
Saltpetre	800,000	495,978
Granulated PVC	50,000	47,610
Caustic soda	180,000	30,485
Soda lye	160,000	123,145
Solvents	40,000	14,150*)

*) data for 1998

Environment protection at "Anwil"

The systematic elimination of the impact on the environment is one of the strategic goals of the Plant's activities. The following main measures are taken to reach this goal:

- Complex control of production activities supported by the introduction of environmental management system consistent with ISO 14001 standard;
- Performance consistent with all the legal regulations and other requirements of environmental protection;
- Constant improvement of technologies so as to produce in the best possible environmental friendly way;
- Minimisation and monitoring of the impact on the environment, especially with respect to air pollution, surface water and soil contamination as well as solid waste management.

Wastewater management

"Anwil" is equipped with a specific system of wastewater management. Wastewater stream from the chlorine and polyvinyl chloride installations, contaminated with organic compounds, together with sanitary wastewater are pre-treated in the industrial pre-treatment plant (Simon-Hartley technology based on stripping and coagulation processes) and further directed to "Group" WWTP in Wloclawek. Other wastewater streams (technological and drainage waters from PVC and fertiliser units) undergo mechanical and chemical treatment in the Central Industrial WWTP.

In spite of the complicated sewage system covering the Plant's area, the wastewater discharged to the surface water bodies is in full consistency with all the requirements set by HELCOM Recommendation 23/11.

Table 41. Average concentration of pollutants in discharged wastewater in comparison with limit values set in HELCOM Recommendation 23/11.

Parameter	Concentration [mg/l]		
	Reached by the plant		Required by HELCOM
	2001	1st half of 2002	
COD	42.8	34.43	250
TOC	—	10.24	80
P-tot	—	0.22	2
N-tot	51.2	42.5	50
Hg	n.d.	n.d.	0.05
Cd	0.008	0.007	0.2
Cu	0.042	0.035	0.5
Ni	0.039	0.008	1.0
Pb	0.043	0.065	0.5
Cr	0.014	0.015	0.5
Cr – VI	n.d.	n.d.	0.1
Zn	0.044	0.044	2.0

n.d. – not detected

According to the requirements of HELCOM Recommendation 17/6, wastewater could be discharged to surface water bodies when their load is minimised by the implementation of BAT, incl. separation of technological and cooling waters. However, the present scheme of wastewater management in "Anwil" does not allow such a separation, mainly due to the complicated system of wastewater collection and treatment. Nevertheless, joint treatment of the streams does not significantly influence the chemical composition of the wastewater and the treatment efficiency for separate treatment would be similar. Although there is no possibility to compare the specific requirements of the HELCOM Rec. 17/6 (lack of data for the wastewater stream from the fertiliser manufacturing unit only), the overall consistence with its requirements could be regarded as reached.

Emission to the atmosphere

In 2001 the Plant emitted 8,167.3 tons of air gas pollution and 747.7 tons of dust. The composition of gas pollution is described in the table below.

Table 42. Emission to the atmosphere in 2001.

Pollutant	Amount [t/year]
Vinyl chloride	35.9
Carbon tetrachloride	1.4
Chlorinated hydrocarbons	21.3
Aliphatic hydrocarbons	30.7
Aromatic hydrocarbons	2.5
Ammonia	76.7
Sulphur dioxide	5,227.5
Nitrogen dioxide	2,434.7
TOTAL	8,167.3

Waste management

According to the requirements of national legislation, solid wastes are to be utilised or disposed of at the source of their origin. Following these requirements, "Anwil" performs advanced waste management:

- Total amount of waste produced in 2001: 66,805 tons (including 60,852 tons of hazardous waste);
- Amount of waste used by the company (hazardous waste): 57,426 tons (94 % of hazardous waste produced);
- Waste provided to third parties: 4,176 tons (including 3,390 tons of hazardous waste);
- Amount of waste disposed of at the company landfill sites: 5,164 tons (including 27 tons of hazardous waste).

In 2001 approx. 5,171 tons of liquid chloroorganic waste produced during the manufacture of chloride and polyvinyl chloride were rendered harmless in the system recovering hydrogen chloride from waste chloroorganic compounds and the hydrogen chloride recovered in the process and heat in the form of vapour were reused in the technological processes.

Application of Best Available Technologies

"Anwil" closely follows all documents in this scope. As of today, there have not been any studies describing the problem in reference to the production technologies used at "Anwil".

Investment activities and their results

Reduction of impact on the environment, improvement of technological safety and workers' health protection were achieved due to the following measures taken:

- Modernisation of wastewater management (including development of the Central Industrial WWTP) made it possible to treat all the wastewater produced at the Plant and create a system facilitating the collection of all wastewater in emergencies.
- Installation of an alkaline vapour treatment system in the saltpetre manufacturing unit significantly reduced the amount of ammonia nitrogen discharged in the wastewater to the receiving waters with simultaneous reuse of the condensate treated. As a result, the discharge of ammonia nitrogen to the Vistula River was reduced by 524 tons/year and the discharge of nitrate nitrogen was decreased by 70 tons /year.
- Modernisation of the water demineralisation station resulted in an approx. 3,300 kg/d decrease in the discharge of sulphates and approx. 2,800 kg/d decrease in the discharge of chlorides.
- De-gassing of steam (3.6 MPa) followed by reforming limited the discharge of ammonia nitrogen and methanol to the Vistula River.
- Implementation of the organic wastewater stripping reduced the discharge of chloroorganic wastewater. After the removal of characteristic substances (ammonia, vinyl chloride) in the stripping process, vapour condensates are returned to the process, contributing to a significant limitation in the load of pollutants discharged.
- A new system enabling the recovery of hydrogen chloride from waste chloroorganic compounds facilitated a return of significant amounts of hydrogen chloride to PVC production process with

simultaneous significant (approx. 3,547 tons /year) limitation in the chloride load discharged to the Vistula River.

- Installation of the so-called precipitated salt made it possible to significantly reduce the load of chlorides and sulphates in the wastewater produced at the chlorine and soda lye unit; additionally, over-sludge fluid from the section of the landfill site designed for the collection of sludge with a high chloride contents is reused at the same unit.
- Replacement of the No. 1 and 2 boiler burners at the company heat and power generation plant with the low-emission ones and installation of the automatic emission measurement system limited the emission of nitric oxides by approx. 20 %.
- Modernisation of the industrial waste landfill site.
- Modernisation of the D-2304B column (replacement of coils in 4 shelves) in the nitric acid manufacturing plant limited the emission of nitric oxides by approx. 38.7 kg/h.

During the years 2000-2001 environmental investment projects cost amounted to PLN 39,823,410 (approx. EUR 10 million) with 25 % share provided by the National Fund for Environmental Protection and Water Management and Provincial Fund for Environmental Protection and Water Management.

Conclusion

Implementation of the environmental policy of "Anwil" is based on the requirements of national legislation supported by other, voluntary agreements. The Environmental Management System consistent with ISO 14001 standard, which was introduced in 2001, enables the overall control of the production activities and their impact on the environment. The Plant is also involved in the "Responsible Care" and "Cleaner Production" international programmes.

In the recent years great attention was paid to water and wastewater management. According to the overall timetable for reduction of adverse impact on the environment, a number of measures were taken and completed. This resulted in the significant reduction of the water consumption and pollution load discharged.

"Siekierki" Heat and Power Plant in Warsaw – Hot Spot No. 83.2

General description

The "Siekierki" Heat and Power Plant is localised on the left bank of the Vistula River in the southern part of Warsaw. It was built in 1962 as a heat and power generating station with electric power of 200 MWe and thermal power of 520 MWt. Warsaw's growing demand for heat resulted in a gradual extension of the plant with eight coal and oil-fired water boilers and four heat units. The extension lasted until 1982.

The "Siekierki" Heat and Power Plant is currently the biggest plant belonging to *Elektrocieplownie Warszawskie S.A*. [Warsaw Heat and Power Generating Plants Joint-Stock Company], which also runs Zeran, Kaweczyn, and Pruszkow Heat and Power Generating Plants and Wola Heat Generating Plant.

Together with its combustion waste disposal site, the plant in question covers approx. 99 ha. It employs (as of 31 December 2001) 413 staff members and focuses on the production and delivery of heat to the heat system of the central and southern part of left-bank Warsaw and power to the National Electric Power System.

Its thermal power amounts to 2,448 MWt and electric power to 622 MWe.

The basic sources of thermal energy include:

- units fired with hard coal:
  - 4 OP-230 steam boilers,
  - 1 OP-380 steam boiler,
  - 3 OP-430 steam boilers,
  - 1 WP-200 water boiler,
  - 3 WP-120 water boilers,
- units fired with mazout – 2 PTWM water boilers.

The "Siekierki" plant is supplied with water from:

- the Vistula and Wilanowka Rivers (surface water);
- municipal water supply system (drinking water);
- groundwater (drainage).

Electric power and heat generated in 2001:

- electric power – 2,610,563 MWt,
- thermal power – 21,429,057 GJ.

Table 43. Basic data on the "Siekierki" Heat and Power Plant.

Power	MWt
Maximum total thermal power	2,448
Maximum thermal power coupled	1,137
Maximum power of heat boilers	1,303
Rated power of heat boilers	1,303
Installed electric power of turbine sets	622
Maximum electric power of turbine sets	619
Maximum net electric power	557

Environmental protection at "Siekierki" Heat and Power Plant

In view of the fact that devices of the collector unit have been used for more than 30 years, and due to the complex process system and a considerable variety of the devices installed (7 types of coal-fired and oil-fired boilers, 4 types of turbines), modernisation of the Heat and Power Generating Plant was commenced a few years ago in order to improve its technical and economic parameters and to satisfy environment protection requirements.

Effluents generated by the Plant are discharged to:

- the Vistula River;
- the municipal sewerage system.

Fuels and pollutant emissions

The table below contains the basic data on the fuels used at the Plant in 2001 and the emissions of pollutants resulting from combustion.

Table 44. Fuels used at the Plant and emissions to the atmosphere in 2001.

No.	Element	Amount	Limit under decision issued by the Provincial Governor
1.	***Hard coal***		
	Consumption [tons]	1,655,510	
	Calorific value [KJ/kg]	22,282	
	Ash contents [%]	21	
	Sulphur contents [%]	0.83	
2.	***Mazout***		
	Consumption [tons]	3,833	
	Calorific value [KJ/kg]	40,600	
	Sulphur contents [%]	2.2	
3.	***Emission of pollutants [t/year]***		
	SO_2	21,377	52,764
	NO_2	6,110	12,120
	CO	756	5,617
	Dust	2,681	7,864
4.	***Emission of pollutants [g/GJ]***		
	SO_2	577	
	NO_2	164	
	CO	20.4	
	Dust	72.4	
5.	***Emission of pollutants [mg/Nm^3]***		
	SO_2	1,470	2,350
	NO_2	427	540
	CO	47	250
	Dust	156	350

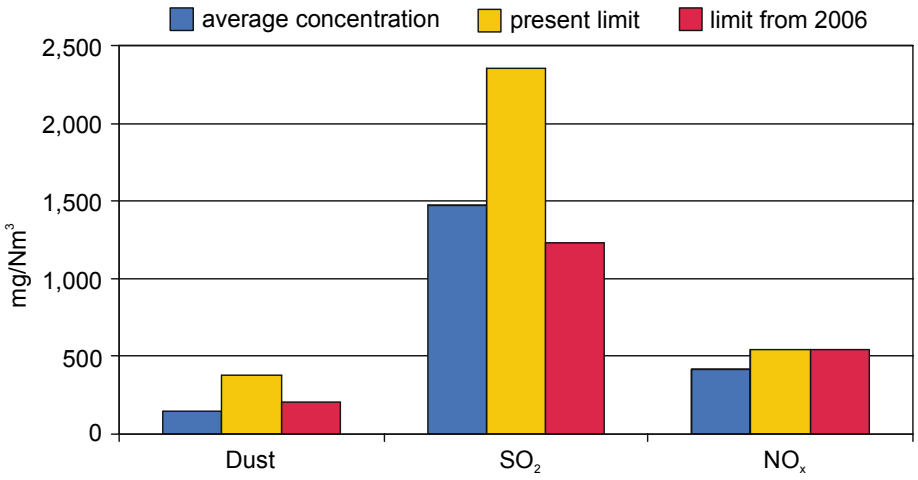


Figure 20. Emission of pollution to the atmosphere in comparison with Polish requirements.

Technologies used

The production of thermal and electric energy at the "Siekierki" plant is based on the combustion of hard coal in steam and water boilers and mazout in two PTWM boilers.

Steam and water boilers are equipped with modern dedusting devices (5 four-zone electrofilters, 5 three-zone electrofilters made by ELWO Pszczyna) with over 99 % dedusting capacity. Additionally, 4 boilers are equipped with a system for the conditioning of exhaust gas in order to increase the effectiveness of dedusting.

In order to reduce the emission of nitric oxides 9 boilers have been equipped with low-emission burners manufactured by IVO (Fortum), RAFAKO, EKO-ENERGIA and STORK, and a low-temperature vortex system in 3 boilers. The above systems guarantee the maintenance of nitric oxides emission at a level below the one required under the Polish regulations in force.

In order to limit the emission of sulphur dioxide, low sulphur content coal is used. In September 2002 the OP-230 no. 2 steam boiler was put into operation after modernisation. The boiler was equipped with a system for semi-dry removal of sulphur from exhaust gas (approx. 85 % sulphur-removal capacity). The boiler is equipped with dedusting devices, including a bag filter (99.9 % dedusting capacity) and FORTUM low-emission burners guaranteeing a 45% reduction in NO_x emission.

Table 45. Basic technical parameters reached by the No. 2 boiler.

Boiler efficiency	$\geq$ 92 %
Concentration of NO_x in exhaust gas	$\leq$ 400 mg/Nm^3
Concentration of SO_2 in exhaust gas	$\leq$ 500 mg/Nm^3
Concentration of CO in exhaust gas	$\leq$ 50 mg/Nm^3
Concentration of dust in exhaust gas	$\leq$ 20 mg/Nm^3

Since 1995 all combustion wastes in the form of fly-ash and slag have been used:

- For the manufacture of building materials and cement (approx. 90 %);
- For the construction of roads and reclamation of degraded land (approx. l0 %).

Environmental projects – air protection

Table 46. Environmental projects implemented in 1990-2001 aiming at the air protection.

Project	Year
System supporting the work of electrofilters (conditioning of exhaust gas) in the OP 430 No. 10,14 and 15 and OP 380 No. 11 boilers	1991
Replacement of electrofilters in the OP 230 No. 1, 2, 3, 4 boilers	1991-1992
Replacement of electrofilters in the WP 120 No. 6 and 7 boilers	1994
General overhaul and modernisation of electrofilters in the WP 120 No. 5, OP 430 No. 10, 14 and 15, OP 380 No. 1 l, WP 200 No. 16 boilers	1994-2000
Reducing the emission of NO_x through the introduction of a low-temperature vortex in the WP 120 No. 5, 6 and 7 boilers	1991-1992
Covering NO_x low-emission burners in the OP 430 No. 10, 14 and 15, OP 380 No. 11 boilers	1995-1999
Covering NO_x low-emission burners in the boilers: OP 230 No. 1 (boiler modernisation), No. 4 and WP-200 No. 16	1997-1999
Modernisation of the system for the conditioning of exhaust gas through elimination of the storage of liquid SO_2 (replacement with granulated sulphur)	2001
Monitoring of emission of dust and gas pollutants	2000
Installation of devices for continuous measurement of SO_2 i NO_x levels in the emission measurement station in Warsaw, Przy Bernardynskiej Wodzie Str.	1996
Modernisation of the 0P320 No. 2 boiler with building of a semi-dry system for the removal of sulphur from exhaust gas (still in progress)	2000 - 2001

The modernisation and investment projects implemented in recent years, a high level of repairs and optimised level of the use of devices made it possible to reach a high degree of coupling of the generation of electric and thermal energy, which has resulted in good economic results and a decrease in the negative environmental impact of the "Siekierki" plant.

The investment projects, modernisations and organisational activity specified above have resulted in a significant decrease in the emission of dust and nitric oxides.

The diagram below shows the emission of pollutants by the "Siekierki" plant since 1990.

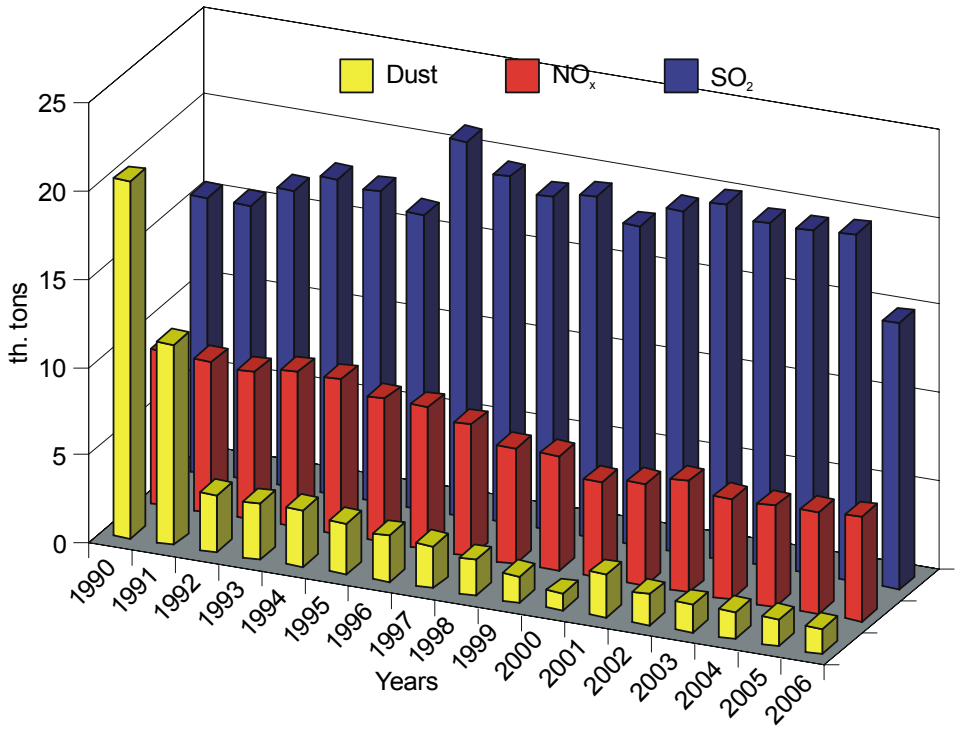


Figure 21. Emission of pollution to the atmosphere [t/year] in 1990-2001 with forecast for 2002-2006.

Environmental projects – water protection

Table 47. Environmental projects implemented in 1990-2001 aiming at the water protection.

Project	Year
Building of an additional intake of cooling water	1993
Building of the mechanical and chemical industrial effluent and rainwater treatment plant	1994
Closing of effluent circulation at the water decarbonisation station	1996
Monitoring of the quality and quantity of water drawn and discharged to the Vistula River	1999

Environmental projects - waste management

Since 1995 all combustion wastes from the "Siekierki" plant have been delivered (under long-term agreements) to the parties finding some use for them, mainly in the cement and building material industry. Approx. 35 ha of dry combustion waste disposal site underwent biological reclamation, protected zone was covered with high vegetation, monitoring of groundwater around the waste disposal site was introduced and ash sprinkling system was installed.

Environmental investment projects - financial outlays and future activities

The anticipated financial outlays for ecological investment projects in 2000-2003 amount in total to approx. EUR 28.25 million – the entire amount is going to be provided by *Elektrocieplownie Warszawskie S.A.*

Table 48. Anticipated financial outlays for ecological investment projects in 2000-2003.

No.	Project	Cost in EUR
1.	Modernisation of the OP-230 No. 2 boiler *Covering low-emission burners, environmental protection system and bag filter*	27,500,000
2.	Covering low-emission burners in the OP-230 No. 3 boiler	460,000
3.	Extension of a system of drainage ditches around the combustion waste disposal site	125,000
4.	Limiting acoustic nuisance	200,000

The "Siekierki" Heat and Power Plant meets the Polish standards in force in the scope of emission of gas pollutants and dust and is not going to exceed the admissible standards which will come into force on 1 January 2006.

In order to be able to meet the 2006 sulphur dioxide standards on the OP-430 and OP-380 steam boilers, low-sulphur content fuel (with sulphur content of up to 55%) will be used.

In relation to the provisions of EU Directive 80/2001 for boilers as a source of emission, it will be necessary to replace or modernise the electrofilters and use low-sulphur content varieties of coal.

If the chimney, to which several boiler units are connected, is treated as a source of emission, the "Siekierki" plant will have to implement expensive investment projects aimed at lowering the SO_2, NO_x and dust emission.

Conclusions

The "Siekierki" Heat and Power Plant was recorded on the list of the most noxious plants (the so-called "List of 80") under a 1990 decision of the Minister of Environmental Protection, Natural Resources and Forestry due to its high total emission of dust and gas to the air, pollution of the Vistula River with the effluents generated at the plant and incorrect disposal of combustion wastes.

As a result of numerous investment and modernisation activities, the emission of gas and dust pollutants was significantly reduced, and the nuisance resulting from the waste disposal and noise generation was also decreased. The problem of the discharge of effluents to the Vistula River was solved.

As a result of all the environmental steps, the Chief Inspectorate for Environmental Protection decided to delete the "Siekierki" plant from the list of the most noxious plants, *i.e.* the "List of 80", on 17 January 2002.

"Boruta" Dyestuffs Plant in Zgierz - Hot Spot No. 90

In 1998 a closing down process of the "Boruta" Plant was started due to the recession and the fall in production. Only "Boruta-Kolor", out of the companies created on the basis of the "Boruta", generates industrial sewage at present. Sewage from the production departments is driven into the sewage system, owned by the Zgierz Water Company, and treated in the biological treatment unit. Released sewage complies with standards specified in the agreement with the Zgierz Water Company.

In 1992 the Town Council took a decision about building a municipal and industrial treatment plant together with ZPB "Boruta". The investment, completed in 1998, has resulted in complex adjustment of water and sewage management.

Pre-treatment of sewage is conducted separately for the municipal sewage and the industrial sewage. There is also a possibility of storing the industrial wastewater which cannot be directly taken to the biological treatment due to its chemical composition.

Average concentration on the wastewater outlet as of 2001 (January – July) was as follows:

- 4.6 mg/l and 98 % reduction of BOD_5;
- 11.7 mg/l and 78.3 % reduction of nitrogen;
- 0.7 mg/l and 88.0 % reduction of phosphorus.

The Bzura River, before the treatment plant was put into operation, had not fallen within any of river purity class and almost all indicators had exceeded permissible standards. Today, the quality of the Bzura River has improved to a great extent.

"Dwory" Chemical Company in Oswiecim - Hot Spot No. 91

The "Dwory" Chemical Firm was established in 1945 and produces a wide range of chemicals. Over the last years big production enterprises have undergone a great transformation in Poland. Crucial changes in production and trade fields, as well as in quality assurance, environmental management and industrial safety systems have been introduced. "Dwory" has also undergone such a transformation. Redundant properties and obsolete technologies have been abandoned. Several hundreds of million PLN have been invested in new installations and environmentally friendly technologies. The employment structure has been optimised and the management has been changed.

The Firm has been undertaking the following initiatives in order to reduce its impact on the environment:

- investment activities;
- modernisation of technological installations;
- construction of installations reducing emissions to the air (built according to the new technologies);
- rationalisation of water consumption;
- closing the cooling circuits;
- construction of treatment plants;
- building of hazardous waste disposal site (according to the latest technologies).

The "Dwory" Chemical Plant has obtained the status of an environmentally friendly company, which in everyday life has been confirmed by introduction of the Environmental Management System and the ISO 14001 standards.

"Boleslaw" Metallurgical and Mining Plant in Bukowno - Hot Spot No. 92

The "Boleslaw" Metallurgical and Mining Plant is the biggest producer of electrolytic zinc in Poland. It is a typical processing and extraction enterprise of the non-ferrous metal industry. The sulphide zinc ore and lead ore are extracted in its own two mines.

The main threats resulting from the metallurgic and mining activities include: drainage, ground deformation, waste generation, mining waters and process wastewater discharge and emission to the air, mainly due to the metallurgic processes.

The "Boleslaw" company has undergone substantial changes since its placement on the Hot Spot List. The pro-ecological initiatives have resulted in a substantial reduction of environmental discharges. The pollutant discharge complies with all the national environmental regulations. Heavy metal concentrations in released waters and wastewater are in compliance with HELCOM Recommendation 23/11. HELCOM Recommendation 9/8 on the BAT has been implemented. Atmospheric emissions comply with the BAT, and consequently, with the European Union standards. There are no existing technological possibilities to reduce the present environmental discharges.

EUR 12.5 million, coming mainly from own resources, have been spent on the implementation of ecological initiatives (other sources: NFOSiGW, WFOSiGW and the Environmental Protection Bank(BOS)).

Salt Control / Vistula Upper Basin - Hot Spot No. 96 and Odra Upper Basin - Hot Spot No. 111

Both Hot Spots were defined as hard coal mines discharging saline waters into the surface waters. The mines in question are located far in the South of Poland and practically exert no negative impact on the Baltic Sea environment.

The monitoring data on the river's water quality downstream of both the spots indicate that as far as heavy metals and salt are concerned, the national and the EU highest standards of water purity are met.

"Police" Chemical Plant in Police – Hot Spot No. 98.1

General description

"Police" Chemical Plant is located in the North-West corner of Poland, by the mouth of the River Odra. The main argument behind the selection of the site in 1964 was the convenient access to seaways and inland waterways facilitating easy water transport.

"Police" is the youngest Polish complex operating in the field of fertilisers. In the 1970s it was one of the leading manufacturers of phosphatic fertilisers in Europe and provided as much as almost 40 % of such fertilizers on the domestic market. An important event in the history of the Plant was the opening of a titanium white manufacturing plant in 1978. The manufacture of the pigment, which is used in paint, plastics, ceramics and textile industries made it possible for the company to open up to other, non-agricultural branches of industry. "Police" continues to be the only manufacturer of titanium pigment in Poland.

Today the Plant manufactures approx. 30 various products in three assortments:

- ferilisers;
- titanium white; and
- chemicals – phosphoric acid, ammonia, sodium fluosilicate.

The high quality of products results from the use of modern technologies which meet world standards. Along with production departments, the plant is composed of several supporting departments, including a wastewater treatment plant, a barge port and transport lines for raw materials, products and waste products.

In 2001 "Police" obtained the ISO 9002 Quality Management System certificate. The Plant is also a holder of a certificate awarded to participants in the "Responsible Care" programme in 1999. In 1998 "Police" was granted a World Environment Center – USA certificate for the phosphogypsum management.

Production profile

Fertilisers

A wide range of fertilisers produced meet the entire range of manufacture covered by HELCOM Recommendation 17/6:

- manufacture of nitrogen containing mixed fertilisers (NP, NPK);
- manufacture of nitrogenous fertilisers;
- manufacture of phosphatic fertilisers;
- manufacture of phosphoric acid.

Multi-component fertilisers manufactured by "Police" are made from ammonium phosphate and urea as well as pure, high-percentage potassium salts (potassium chloride and potassium sulphate) and a very good quality magnesite.

Along with mixed mineral fertilisers, the range of products also include nitrogen fertiliser with 46 % of urea and a very low contents of biuret.

Titanium White

The TYTANPOL® titanium dioxide pigments are manufactured by the sulphate method. Over the years "Police" SA have modernised the systems and broadened the range of varieties offered. The current titanium white manufacturing process makes it possible to manufacture eleven rutile and three anatase varieties. TYTANPOL® pigments are widely used in paint and varnish industry as well as in plastics, paper, rubber, textile, ceramics and electroceramics industries. Licences issued by the State

Hygiene Institute, under which they may be used for products having contact with foodstuffs, are available for most of the pigments. TYTANPOL® R-001 has been approved for the manufacture of drinking water pipes in the USA (NSF International certificate No. 14).

Chemicals

The chemicals group includes such products as phosphoric acid, sulphuric acid, ammonia, sodium fluosilicate and ferrous sulphate as well as phosphogypsum and ammonia water. Sulphuric acid and phosphoric acid have been manufactured since the establishment of "Police". In subsequent years the range of chemicals manufactured was gradually extended. They are used for the manufacture of mineral fertilisers by the plant and are sold to external customers. They are used in the building industry, chemical industry, glass and ceramics industry, cellulose and paper industry, for the manufacture of fertilisers, fodder mixes, water and sewage treatment agents, drinking water fluorination and for other purposes.

Volume of production

Table 49. Annual production volumes in groups of products.

Products manufactured	Company profile *)	Volume of production [tons/year]	Manufacturing process
NP, NPK, MAP,PK	A, C	1,187,440	Synthesis of ammonia with phosphoric acid by the Dow-Oliver and Fisons methods.
Urea	B	244,170	Synthesis of ammonia with carbon dioxide by the Stamicarbon method.
Phosphoric acid	D	398,769	

*) Classification according to HELCOM Recommendation 17/6

A: manufacture of mixed fertilisers (NP, NPK); B: manufacture of nitrogenous fertilisers (N);

C: manufacture of phosphatic fertilisers (P, PK); D: manufacture of phosphoric acid

Supplementary manufacture	Volume of production [tons/year]
Sulphuric acid	561,000
Titanium white	38,098
Ammonia	345,690
Sodium fluosilicate	1,136

Environment protection at "Police" Plants

For many years the "Police" Plant has been recording a marked progress in the limitation of both load of pollutants discharged to surface waters and those emitted to the air. The problem of waste has been practically solved owing to wide-scale investment projects resulting in spectacular changes in the environmental impact of the Plant. Forecasts and investment projects planned by "Police" confirm that the positive tendencies in the scope of further elimination of pollutants will be continued.

Today practically all the manufacturing systems complete with the wastewater treatment plant have been modernised and upgraded. The changes implemented have minimised the environmental impact of "Police", and have therefore had a beneficial effect on the flora and fauna in the vicinity of the Plant.

Water and wastewater management

"Police" pays a lot of attention to the protection of surface and ground water in its water and wastewater management policy. In the last few years a number of projects were implemented in order to improve water quality. Wastewater treatment plant was modernised, the load of pollutants discharged to the receiving water decreased and an effective system of band ditches around the phosphogypsum and ferrous sulphate landfill sites was created. At the moment the treated wastewater is discharged to Roztoka Odrzanska, consistently meeting all the standards in force both in Poland and in the European Union.

The technological stages at the company wastewater treatment plant are as follows:

- neutralisation with milk of lime;
- coagulation and aeration;
- sedimentation in sedimentation tanks accelerated with polyelectrolytes;
- fluid remaining above the sediments flows to the storage and equalisation tanks, where it undergoes natural biotreatment processes;
- the precipitated sediments go through concentrators to setting centrifuges.

Table 50. Average concentration of pollution in treated wastewater (2001) in comparison to limit values set in HELCOM Recommendation 23/11.

Parameter	Concentration [mg/l]	
	Reached by the plant	Required by HELCOM
COD	26.9	250.0
P-tot	0.37	2.0
N-tot	2.5	50.0
Hg	0.007	0.05
Cd	0.006	0.2
Cu	0.013	0.5
Ni	0.032	1.0
Pb	0.029	0.5
Cr-tot	0.072	0.5
Cr-VI	0.048	0.1
Zn	0.122	2.0

"Police" Plant manufactures a complex range of products for all activity profiles (A, B, C and D) specified in HELCOM Recommendation 17/6. The wide range of products manufactured requires the use of a diverse raw material base and a large number of production systems, which is simultaneously reflected in the qualitative and quantitative composition of pollutants in the sewage discharged. The wastewater from all the systems located in the Plant complete with leakage from the landfill site is directed to the company wastewater treatment plant. Additionally, municipal wastewater from the

town and commune of Police (population 40,000) has also been directed to the company treatment plant since 1998.

In view of the above, a direct reference to the admissible pollutant values for the particular product groups falling within the activity profiles specified in the Recommendation 17/6 is impossible. Additionally, the wastewater discharged to the surface water after treatment meets all the standards resulting from other HELCOM recommendations as well as national regulations in force in Poland.

Emissions to the atmosphere

In recent years practically all the company units have been modernised, which considerably reduced the emission of particulate and gas pollutants to the atmosphere. Today the emission of fluorine, ammonia, sulphur dioxide, nitric oxides and other substances does not exceed the relevant standards. Also work on the neutralisation of odorous compounds has been commenced, which is a pioneering task in global terms. The first results are very promising. Additionally, land reclamation is constantly in progress on the phosphogypsum and ferrous sulphate heaps. This subsequently limits the dust-dissemination area, which anyway is already quite small.

In 2001 "Police" emitted to the atmosphere 148.29 tons of dust, 12.24 tons of fluorine compounds and 41.77 tons of NO_x.

Table 51. Emission of the pollution to the atmosphere (2001) in comparison with limit values set in HELCOM Recommendation 17/6.

Parameters	Concentration [mg/Nm^3]	
	Reached by the plant	Required by HELCOM
NO_x	7.03	500
Dust	16.86	75
Fluorine compounds	1.98	5
Chlorine compounds	- *)	30

*) The Plant does not manufacture products based on chlorine-containing raw materials, so there is no emission of chlorine compounds. Possible trace amounts may result only from impurities of raw materials and are successfully eliminated by the air protection equipment.

Modernisation of the systems functioning at the Plant has largely contributed to the limitation of the air pollution. This included:

- installation of low-emission burners at the company heat and power generating plant;
- outfitting the system with carbon filters, cyclones, electrofilters and scrubbers;
- encasement of the conveyors transporting raw materials, products and waste;
- changes in the structure of manufacture, a decrease in the consumption of energy, fuels, raw materials and water, and a decrease in the production of industrial waste.

In the past the power fuel combustion was the main source of emission of SO_2 and NO_x at Police. The majority of primary energy generated by the Plant originated from systems fuelled with hard coal and furnace oil. Today, although hard coal and furnace oil still constitute the fuel basis, the Plant has managed to markedly decrease the emission of pollutants. This resulted from a decision to use the low sulphur content fuel and low-emission burners as well as the erection of a system for desulphurisation

of post-process gas. Replacement of the sources of energy used with natural gas in the technological systems was an additional important factor contributing to the protection of the atmosphere.

Waste management

Waste management at "Police" is consistent with the European environment protection standards. The basic waste streams produced by the Plant as a result of the manufacturing processes include:

- Phosphogypsum – a by-product generated during the manufacture of phosphoric acid from phosphate; phosphogypsum is disposed of at the landfill site almost in total, with the exception of small amounts of apatite phosphogypsum, which is mainly used for mushroom production and in cement mills.
- Ferrous sulphate (II) – used in the manufacture of coagulants for wastewater and water treatment as well as stabilisers for cement industry.
- Wastes resulting from power fuel combustion, *i.e.* ash and slag – almost all are used for industrial purposes, and only wastes from the pulverised-fuel boilers are disposed of at the landfill site.
- Sediments from the wastewater treatment plant and those resulting from decarbonisation – all are used for land reclamation at the phosphogypsum landfill site.

The remaining wastes are not significant industrial stream wastes and are largely used for industrial purposes or are disposed of.

Phosphogypsum is the main stream of waste which is almost in 100 % disposed of at the company landfill site, in contrast to the other wastes which are largely used for industrial purposes. Today the industrial use of the waste generated during the process of obtaining pure phosphoric acid is limited by the governmental environment protection regulations all over the world, primarily due to the contents of pollutants such as radionuclides (radium 226 and radium 228). That is why also in Poland the waste is used to a very limited degree.

Due to the probability of the presence of hazardous substances in the waste, the company phosphogypsum landfill site is equipped with model protection facilities – a system of band ditches, which entirely exclude any environmental contamination. It is the only functioning landfill site in the world in such a good condition.

In order to eliminate secondary environmental pollution resulting from the transport of the waste to the landfill site, the Plant has built a system of belt conveyors for the waste to be transported directly to the landfill site. The leakage from the landfill site is accumulated in the ditches and is then constantly pumped to the company wastewater treatment plant. Additionally, to make sure the environment is fully protected, the landfill site has been surrounded with 2.2 m high flood embankments and a system of drainage ditches.

Environmental investment projects

In order to maintain the required technical condition of the systems and for the purposes of a continuing minimisation of environmental impact, modernisation and investment projects are implemented in the Plant on an annual basis. A significant portion of the projects concern the protection of human health and process safety. Activities under the "Responsible Care" programme

aimed at the limitation of the negative environmental impact also include the repair of the system apparatuses.

In 1998-2001 projects aimed at the minimisation of the environmental impact of "Police" and environmentally friendly investment projects included:

- Replacement of boiler burners with low-emission devices at the company EC II heat and power generation plant and replacement of electrofilters, resulting in a decrease in the emission of NO_2 and dust to the atmosphere.
- Introduction of desulphurisation of post-calcination gas from the titanium white manufacturing plant, which reduced the emission of SO_2 to the atmosphere by 80 %.
- Replacement of the system of drainage of leakage from the ferrous sulphate (II) landfill site, which eliminated the possibility of leaks from the landfill site to the soil.
- Construction of a 640-meter-long salt transport system from the barge port to the fertiliser manufacturing plants; the investment project resulted in reduction of the emission of dust into the atmosphere, eliminated soil pollution resulting from the motor transport and improved the technical safety.
- Modernisation and construction of flood embankments around the phosphogypsum landfill site (total length: 3,345 m), which decreased the flood risk in the area of the phosphogypsum landfill site and the neighbouring hydraulic engineering structures.
- Repair of the pier at the treated wastewater storage and equalisation tank (length: 1.386 m) and a 2,066-meter-long embankment, resulting in an increase in the reduction of ammonia ion in the wastewater treated through buffering in the tank in which the additional natural treatment takes place.
- Replacement of vapour scrubbers at the multi-component fertilisers (NP and NPK) manufacturing systems, aimed at compliance with the environment protection regulations in the scope of the emission of particulate and gas pollutants to the atmosphere.

Table 52. The total investment cost of environmentally friendly projects in 1998 – 2001.

Year	Investment outlays [millions of €]	Share of funding supplied by the National Fund for Environmental Protection and Water Management [%]
1998	4.6	2.8
1999	4.2	17.1
2000	3.2	29.0
2001	2.4	0.0
Total	**14.4**	**12.3**

Monitoring of environmental impact

In order to increase the effectiveness of environment protection activity, the "Police" Plant constantly monitors its environmental impact on the individual sectors of the environment. The monitoring covers:

- Surface water and groundwater drawn;
- Treated wastewater discharged as well as cooling water and rainwater;

- Teakage from landfill sites;
- Surface and ground water around landfill sites (monitoring of landfill sites),
- Air quality (ambient air pollutant concentration – 24-h sampling monitoring) with the determination of:
  - wind speed,
  - wind direction,
  - precipitation and temperature;
- Hydraulic engineering structures.

The appropriate steps aimed at decreasing the environmental nuisance of the Plant are undertaken on the basis of the results obtained.

Planned environmental investment projects and the expected results

Environmentally friendly investment projects planned for the forthcoming years include:

- Installation of vacuum pumps at the phosphoric acid concentration system, which will result in a limitation of the total demand for water for manufacturing purposes, and a decrease in the amount of wastewater discharged.
- Connection of sewerage system to the company wastewater treatment plant, which will limit the amount of municipal sewage discharged directly to the Odra River and the Szczecin Lagoon.

Conclusions

In appreciation of the achievements of the Plant in the field of environment protection, "Police" was awarded a „Responsible Care" certificate by the Chapter of the programme in October 1999. The following year the Plant managed to maintain the certificate, which was granted on the basis of the 2000 audit confirming the company's ecological achievements. Yet another token of appreciation for the company's green activity was the SUPER-EKO 2000 award granted during the POLEKO 2000 Fair. Handing in the SUPER-EKO 2000 to representatives of the Plant, Presidents of the International Poznan Fair and the National Fund for Environmental Protection and Water Management recognised the presence of "Police" at the POLEKO 2000 Fair as a symptom of a new trend in the attitude to ecology by the branch of industry traditionally considered to be environmentally unfriendly.

The awards and recognitions obtained confirm that "Police" has a serious attitude to the ecology-related questions and undertakes wide-scale activity aimed at the maximum possible lowering of the negative environmental impact of the Plant.

It should be stressed that the company's environmental activity is not limited to investment projects implemented and planned in connection with the company business or the awards obtained. "Police" SA is also involved in the treatment of municipal sewage from Police. An investment project involving the use of a modern company treatment plant was finished as planned and owing to that the municipal sewage pumping station, started-up in August 1998, directing sewage from the municipal treatment plant to the company facility has solved the problem of treatment of the Odra River for years to come.

Realising the importance of co-operation of all circles in the environmentally friendly activity, "Police" initiated and commenced the implementation of the "Partnership for Environmental Protection" programme. Under the programme, the company co-operates with the local organisations

and publishing houses promoting activity for the benefit of the natural environment. On the one hand, the Plant is becoming a patron for ecological organisation, and on the other hand, the fact that such co-operation is possible is an evidence of the understanding for the environment protection activity of "Police".

"Central" WWTP in Poznan - Hot Spot No. 99

The "Central" WWTP is a mechanical–biological plant with additional nutrients removal processing of the municipal wastewater from the city of Poznan. The maximum capacity is 200,000 m^3/day (1,200 PE). An average amount of wastewater inflowing to WWTP is 140,000 m^3/day (900,000 pe). The receiving body is Warta River (discharging to Odra River).

The plant's start-up began in August 1999. In the beginning of 2000 the required treatment efficiency was achieved:

- 5.68 mg/l and 99 % reduction of BOD_5;
- 10.4 mg/l and 84 % reduction of nitrogen;
- 0.57 mg/l and 96 % reduction of phosphorus.

The total cost of the investment amounts to approx. EUR 102 million (loan from NFOSiGW and WFOSiGW, PFOSiGW, GFOSiGW, Danish Government, EcoFund, state and city budgets, own resources).

"Lacza" WWTP in Zielona Gora – Hot Spot No. 101

"Lacza" WWTP at Zielona Gora was built by "Lacza" Water and Wastewater Company established in 1985 especially for the purpose of construction of the plant as well as sewerage and a channel discharging it to the receiving water.

Approx. 94 % of the population (112,000 citizens) benefit from the services of sewage discharge and treatment. Approx. 90% of the town area is equipped with the sewer system. Further sewerage development is planned.

The plant treats sewage using both mechanical and biological methods. Its capacity is 51,200 m^3/d for 195,000 PE and the plant works using a three-stage biological sewage treatment system with biological dephosphatation, denitrification and nitrification. Sewage from the town flows to the plant in an open sewer used for the retention of the inflowing rainwater. The sewage treatment plant was put into operation on 31 December 1998.

Table 53. Compliance of outflow parameters (2001 and 2002) with HELCOM and EU requirements.

	Outlet parameters					
	Reached by the plant				Required by	
	Concentration [mg/l]		Reduction [%]		HELCOM	EU
	2001	2002	2001	2002		
BOD_5	6.2	6.3	99	98	15 mg/l and 90 % reduction	25 mg/l or 70-90 % reduction
COD	26	23	97	97	—	125 mg/l or 75 % reduction
N-tot	14.5	11.8	73	77	10 mg/l or 70-80 % reduction	10 mg/l or 70-80 % reduction
P-tot	0.4	0.4	95	96	1.5 mg/l	1 mg/l or 80 % reduction

The treated sewage discharged to the receiving water (*i.e.* the Odra River) meets all the national standards, EU Directives and HELCOM Recommendations with the exception of those pertaining to total nitrogen concentration. However, the alternative condition (*i.e.* above 70 % reduction in the percentage of the total nitrogen) has been met.

Sludge management

Some of the sludge from preliminary sedimentation tanks is recirculated to reach biological treatment degree, and the remaining amount undergoes appropriate processes in the gravitational thickeners and chamber press, and is then transported to the municipal waste sewage composting plant.

Good sludge quality, as regards the heavy metals content, enables it to be used for agricultural purposes.

Table 54. Average concentration of heavy metals in sewage sludge.

	Fe	Zn	Cu	Ni	Pb	Cd	Cr
Average concentration [mg/kg]	2,500	620	81	44.4	110.1	9.1	21.3
Most stringent limit values [mg/kg]	—	2,500	800	100	500	10	500

Financing of the investment

Construction of the sewage treatment plant was financed from the following sources:

- City of Zielona Gora;
- Company's internal funds;
- National Fund for Environmental Protection and Water Management;
- Provincial Fund for Environmental Protection and Water Management;
- Phare CBC Programme;
- Foundation for Polish-German Co-operation;

- Danish Environmental Protection Agency;
- Subsidy for the purposes of the project;
- Other sources.

The total share of non-returnable funds in the building cost amounted to more than 30%.

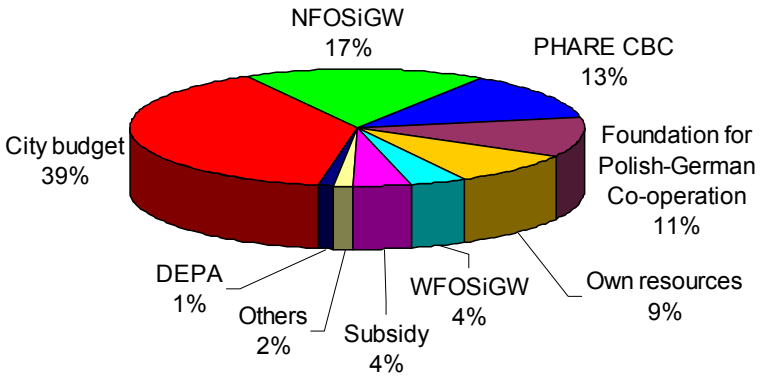


Figure 22. Sources of financing of completed investment at the Hot spot.

"Prochowickie" Poultry Processing Plant in Prochowice – Hot Spot No. 102.1

General description

The "Prochowickie" Poultry Processing Plant was established as a result of privatisation processes and the subsequent 1994 transformation from a plant belonging to the State Treasury into a private company. It became property of the ANIMEX S.A. Capital Group. At that time the company activity was based on slaughter and partition of poultry, manufacture of cured meat, smoked meat, ready-to-cook foods, canned foods and meat-and-bone meal. In 2000 the company ceased to slaughter poultry and to manufacture meat-and-bone meal from slaughter by-products, limiting its range of products to cured meats, smoked meats, ready-to-cook foods and canned foods.

In June 2001 the "Prochowickie" Plant stopped the manufacture of cured meats and ready-to-cook foods, concentrating on the development of canned foods manufacture.

At the moment the company employs 120 persons and manufactures approx. 350 tons of various canned meat foods a month.

Environment protection at the plant

Companies belonging to the ANIMEX group are located around the whole country, including areas of outstanding value from the environmental point of view in Warmia, Mazury and Pojezierze Suwalskie (Polish lake districts). They manufacture high-quality products from ecologically clean raw materials, maintaining due respect to the natural environment. The localisation of the companies and the scope of their activities obliges to undertake steps aimed at the environment protection to exercise better control and decrease the environmental impact to a minimum. In recent years the "Prochowickie" Plant has been paying particular attention to the environment protection. Its steps in this scope have resulted in a significant improvement in the impact of the plant on all elements of the environment. There has been

a significant improvement in the water and sewage management. Solid waste management and emissions of pollutants to the atmosphere have also been reduced. Additionally, the development of the plant also contributed to that, *e.g.* through the limitation of production having a negative impact on the environment.

Water and sewage management

The company is equipped with its own mechanical and biological effluent treatment plant, treating all the wastewater produced on the premises. The plant is able to treat the maximum of 434 m^3 of wastewater a day, which is sufficient in the current situation of the company – it has ceased to slaughter poultry and stopped the manufacture of meat-and-bone meat, cured meats and giblets.

Table 55. Average concentration of pollutants in treated wastewater (2002) in comparison with limit values set in HELCOM Recommendation 17/10.

Parameters	Concentration [mg/l]	
	Reached by the plant	Required by HELCOM
COD	52	250
BOD_5	10.7	25
P-tot	0.86	2*)
N-tot	5.8	—
$N\text{-}NH_4$	2.6	10*)

*) relevant for the plants discharging more than 500 m^3 wastewater/day.

In consistency with the new permit concerning the discharge of sewage obtained by the company in July 2000, the sewage discharged meets the Polish standards. The composition of the treated effluents is analysed by an independent laboratory of the Municipal Water Supply and Sewage Disposal Plant in Lublin. The results of the analyses indicate that the requirements of HELCOM Recommendation 17/10 which covers food industry are met as well.

Emission to the atmosphere

The company holds a permit specifying the admissible levels of emission of pollutants to the air from two sources of pollution: the company boiler plant and the ammonia cold stores.

The company boiler plant is equipped with two identical steam boilers with heat capacity of 10.44 GJ/h and one steam boiler with heat capacity of 11.77 GJ/h. The boilers have one emitter to which the exhaust gas resulting from the combustion of hard coal is directed. For the purposes of air protection each boiler is equipped with a battery of CE 2x1000/0.5 cyclones.

In consistency with the conditions specified in the decision on the admissible emission amounts, the boiler plant does not exceed the limit values for each of the boilers.

Table 56. Emission of pollution to the atmosphere from the boiler plant (2001).

Parameter	Emission [mg/m^3]
SO_2	2,000
NO_x	400
CO	250
Dust	1,900

Measurements have not disclosed any excess emissions.

For ammonia cold stores, the maximum emissions do not exceed:

- 0.3 kg NH_3/h for engine room with one fan of the output of 4,200 m^3/h and one emitter;
- 0.01 kg NH_3/h for switching station with two fans of the output of 5000 m^3/h and two emitters.

Waste management

As of today, the plant manufactures products without producing much waste. The concentration of the manufacture on canned meat foods does not result in the production of much process wastes. The production of waste in the amount of below 1,000 tons results largely from the need to provide services to the plant. The obligations resulting from the Polish regulations pertaining to the management of waste produced are satisfied largely through the disposal of the waste or the provision of the waste for recycling to companies holding the appropriate permits.

Environmental investment projects

The limitation of the manufacturing profile, ecological investment projects implemented at the beginning of the 1990s, regulation of water and sewage management and waste management as well as meeting the emission standards by the plant have resulted in focusing on the elimination of the excess noise generated by the company. In 2002 the Prochowice branch started to implement an investment project entitled „Modernisation of the Ammonia Condensation Station" aimed at the elimination of the environmental impact in question. The total cost of the investment project in question will amount to EUR 100,000. Under the project, five currently used condensers will be replaced with two spray and evaporative condensers.

Conclusions

In the 1990s the Plant slaughtered and processed poultry on a large scale. The activity was connected with the need to discharge approx. 2,500 m^3 of wastewater a day and the effluents were marked by a changeable chemical composition and did not meet standards specified in the permit to draw water and discharge wastewater. The sheer amount of the effluents discharged and their environmental nuisance combined with insufficient preparation of the company wastewater treatment plant made the company undertake steps aimed at a decrease in the amount of loads discharged to surface water. In 1991, stage one of the modernisation of the company sewage treatment plant was completed, which involved a replacement of the aeration system with a fine-bubble system using ceramic diffusers and an installation of highly efficient blowers in order to increase the amount of air supplied to the effluents. Sludge drying beds were repaired and the wastewater treatment plant was subsequently insulated.

As a result of financial difficulties, the company has not started stage two of the investment project yet. However, as a result of the 2000 decision to stop the slaughter of poultry and the manufacture of

meat-and-bone meal from by-products, as well as the 2001 decision to stop the manufacture of cured meats and ready-to-cook products, the amount of wastewater produced and the loads of pollutants in the wastewater were significantly decreased. The modernized wastewater treatment plant fully meets the needs of the plant and its effectiveness satisfies the requirements specified in the Polish standards and HELCOM Recommendation 17/10.

KGHM "Polish Copper": "Glogow" Copper Works - Hot Spot No. 102.2 and "Legnica" Copper Works - Hot Spot No. 102.3

General description

KGHM "Polish Copper" is one of the world leading manufacturers of copper and silver. In 2000 approx. 3.3 % (486,000 tons) of the global copper production came from Lubin. The main product offered by the company is electrolytic copper, including copper rod, its more processed variety, manufactured in accordance with the ISO 9002 standards. Other products offered include gold, silver and crude lead.

The basic technological facilities of KGHM include three mines, three mills, ore enrichment plants and a hydraulic engineering plant. At KGHM, copper ore is mined at mines localised in Lubin, Polkowice-Sieroszowice and Rudna. The total annual yield of the mines amounts to approx. 27 million tons of ore, which is used for the manufacture of concentrate. The final product – electrolytic copper and copper rod are manufactured at three mills: "Legnica", "Glogow" and "Cedynia".

"Glogow" Copper Works

The mill is composed of two units: "Glogow I" and "Glogow II". "Glogow I", a mill using the shaft furnace technology, was put into operation in 1971. "Glogow II" was opened in 1978 and uses a modern fluidised-bed furnace technology. Both mills manufacture electrolytic copper in the form of cathodes, containing the minimum of 99.95% copper. In 1990-1993 the Precious Metals Unit was opened at the "Glogow" Copper Works and it is there that metallic silver, gold, palladium and platinum slime and technical selenium are recovered from the anode slime – a by-product obtained during the manufacture of electrolytic copper. The manufacture of precious metals is based on a technology developed by Boliden Contech AB. Other products include crude lead, sulphuric acid, nickel sulphate and sodium arsenate.

Table 57. Products and production capacity of the "Glogow" Copper Works.

Basic finished goods	**Production capacity [t/year]**
Electrolytic copper-cathodes	392,000
Silver	approx. 1,100
Gold	approx. 500
Finished by-products	
Crude lead	approx. 13,000
Sulphuric acid	approx. 400,000
Nickelous sulphate	approx. 1,300
Sodium arsenate	approx. 90
Pd-Pt slime	approx. 0.105
Selenium	approx. 60

"Legnica" Copper Works

The "Legnica" Copper Works is the oldest metallurgical plant in post-war Poland, processing domestic copper ore. The first tapping of copper took place on 24 December 1953. In 1959 devices facilitating the servicing of the entire technological cycle (from concentrate or other copper-bearing raw materials to the final product) were put into operation. Currently manufacture in the mill is based on copper ore concentrates from the mining units of KGHM "Polish Copper" and other ore-bearing raw materials.

Table 58. Products and production capacity of the "Legnica" Copper Works.

Basic finished goods	**Production capacity [t/year]**
Electrolytic copper - cathodes	93,000
Ingots from continuous casting	35,000
Finished by-products	
Sulphuric acid	105,000
Copper sulphate	6,000
Nickel sulphate	500
Lead concentrate	10,000
Silver in anode slime	230

Copper manufacture technology

The ore extracted (with 1.3-2.3 % copper content) is first crushed and ground and then undergoes flotation at enrichment plants. The concentrate (with 17-31 % Cu content) is filtered, dried, and transferred to the mills, whereas floatation wastes (with 0.17-0.27 % Cu content) are disposed of at a disposal site (water transport). From the administrative point of view, there are two mills: "Legnica" Copper Works and "Glogow" Copper Works. However, the "Glogow" Works is composed of two different technological lines – "Glogow I" (with technology similar to the one used at the "Legnica" Works) and a younger "Glogow II" (based on the fluidised bed furnace technology).

At "Legnica" and "Glogow I" the concentrate is mixed with post-sulphate liquor (10-11 % liquor), and is then once again dried and briquetted. Briquettes with coke (5-8 %) and Bessemer slag (a dozen or so %) are put into shaft furnaces, where copper matte is smelted. Shaft slag is transported to the slag dump and is then processed to become road aggregate. After being dedusted, gas from the shaft furnaces (containing 10 % of CO) is combusted at the heat and power generating plant as additional fuel, and sulphur is then removed from exhaust gas produced by the heat and power generating plant. Liquid copper matte (which mainly contains Cu_2S) is directed to converters, where copper sulphide reacts with oxygen (supplied in the in-blown air). As a result, the converter copper (98-99 % purity) and sulphur dioxide are obtained. Converter copper undergoes thermal and electrolytic refinement to reach 99.95 % purity. Sulphur dioxide is used in a classical way in sulphuric acid factories constituting an integral part of the mills. Dust and slime collected by dedusters at the three mills is used for the manufacture of crude lead at "Glogow I" Works.

The process of copper heat at "Glogow II" Works takes place in a fluidised-bed furnace, which is supplied with a very dry dust concentrate, and the air blown-in to the furnace is enriched with oxygen. As a result copper (the so-called blister) is obtained, similar in contents to the converter copper, which is directed to anode furnaces and subsequently processed similarly as in other mills. Copper is removed from the slag from the fluidised-bed furnace in an electric furnace. Gas from the fluidised-

bed furnace goes through the heat-recovering boiler, and is then dedusted and directed to the sulphuric acid factory. Slag from the electric furnace is granulated on site and used in mines for hydraulic floor. Gas from the electric furnace, after being dedusted in bag filters, is discharged to the atmosphere. Anode slime produced during electrorefinement in all three mills is used for the manufacture of silver and gold at the precious metals department located at "Glogow II".

Environment protection at KGHM "Polish Copper"

In the area of both copper mills emissions are continuously measured by automatic devices, confirming a radical reduction in emissions. The contents of total suspended dust in the vicinity of the mills and the post-floatation wastes tank does not exceed 50 % of the admissible standard (75 $\mu g/m^3$). Mean annual concentrations of sulphur dioxide in the mills impact zones are not only much lower than the admissible Polish standards amounting to 40 $\mu g/m^3$, but are also consistent with the European Union regulations (20 $\mu g/m^3$) which are going to become effective in 2005. The concentrations of sulphur hydrogen, carbon oxide, as well as copper and lead in suspended dust are also maintained at the levels below standard values. Due to the lack of technical possibility for the total elimination of the noxiousness of copper industry, protective zones have been created. The zone around the "Glogow" Works covers 2,840 ha (including the buildings/structures of the mill) and 1,127 ha around the "Zelazny Most" tank (excluding the tank). The zone of the Legnica Works, which initially covered 1,128 ha, was decreased by 44 % and currently covers 631 ha. Almost the entire area of the zones around the mills has been purchased [by the plant], with previous residents moved to other places and trees/grass planted and other plants produced for industrial purposes. In the zone around the "Zelazny Most" tank trees have also been planted as scheduled. At the moment most attention is focused on waste management, and in particular full recycling of slag and the search for use of the material.

Water and wastewater management

All three mills, *i.e.* "Glogow I", "Glogow II" and "Legnica", have target chemical effluent treatment plants. Industrial wastewater, *i.e.* mainly overfalls from cooling circulation systems, together with acid effluents (after neutralisation and clarification), sanitary sewage after remaining in Imhoff sedimentation tank and retained rainwater are jointly directed to the chemical treatment plants. Treatment technology is based on coagulation with ferric sulphate, pH correction with milk of lime and flocculant enhanced sedimentation. The efficiency of all effluent treatment plants at the mills (depending on the type of pollution) reaches 40-99 %, the contents of suspended matter in treated effluents amounts to several mg/dm^3, and the contents of heavy metals is recorded at the tenth and hundredth parts of mg/dm^3.

In recent years special attention has been turned to rational water management in the plants and the closing of cooling circuits, which has significantly reduced the amount of effluents discharged. In total, the volume of effluents discharged from all three mills decreased from 44,112 m^3/day in 1986 to 13,126 m^3/day in 2001. The most significant was closing of the anode cooling circuit at the "Glogow I" Works, which took place in 1999 as a part of modernisation of the anode furnaces, and resulted in a 40 % decrease in the amount of effluents discharged by the mill in comparison to 1998.

Table 59. Average concentration of heavy metals in treated wastewater in comparison with limit values set in HELCOM Recommendation 23/7.

Parameters	Concentration [mg/l]			
	Reached by the mill			Required by HELCOM
	"Glogow I"	"Glogow II"	"Legnica"	
Ag	n.d.	n.d.	n.d.	0.2
Cu	0.030	0.136	0.146	0.5
Ni	0.077	0.071	0.154	1.0
Pb	0.153	0.044	0.020	0.5
Cr-tot	n.d.	n.d.	n.d.	0.7
Cr-VI	n.d.	n.d.	n.d.	0.2
Zn	0.040	0.034	0.484	2.0

n.d. – not detected

KGHM "Polish Copper" does not discharge cadmium, mercury or chromium in its effluents. If the elements or compounds containing them are present in the effluents discharged, they come from the water drawn for technological purposes and the concentrations are marginal and significantly lower than those recommended in HELCOM Recommendation 23/7.

Emission to the atmosphere

The copper mill industry is based on technologies which have a very special impact on the type and level of emissions of pollutants to the atmosphere. The main pollutants used to be sulphur dioxide, carbon oxide and metal-bearing dust, and the main sources were metallurgical furnaces, refinement processes, technologies connected with waste management and transport devices. Sulphur dioxide released during conversion is used for the manufacture of sulphuric acid in most copper mills in the world, and the degree of its recycling reflects the level of development of a given branch of industry and its ecological attitude. At KGHM the efficiency of sulphuric acid factories operating to satisfy the needs of all three mills reaches more than 97 %. The fluidised-bed furnace technology used in the Polish "Legnica" and "Glogow I" copper works has significantly reduced the emission of metal dust and carbon oxide, which until the introduction of the appropriate modernisation determined the noxiousness of the entire industry. However, this already belongs to the past. A more recent technology of a bed-bed furnace used at "Glogow ll" has turned out to be much more environmentally friendly from the very beginning.

At the moment all the shaft gases (containing approx. 10 % of CO) are first dedusted and then burnt at local heat and power generating plants. Sulphur is removed from the plant exhaust gas.

In recent years special attention was focused on the reduction of non-organised emissions. In each of the mills very effective (dedusting to below 10 mg/Nm^3) bag filters have been installed for ventilation gases from the concentrate unloading plant, briquetting machines, transport lines as well as loading and tapping sections of shaft furnaces.

Emissions of gas (mainly sulphur dioxide and carbon oxide) and metal-bearing dust, especially by mills, caused most nuisance of the copper industry for the first twenty years since its beginning. Activity aimed at a reduction of the noxiousness has been carried out since the beginning of the industry, but its effectiveness was not satisfying for many years. A consistent policy adopted by

KGHM and the possibility of the introduction of new technical solutions, especially in the last decade, and with significant financial outlays, resulted in a maximum hermetisation of all processes and the use of the main stream of process gases, with neutralisation of those less important. The level of gas and dust emission was stabilised, and the small differences specified in reports are insignificant and mainly result from the nature of measurements and sensitivity of the analytical methods. Various atmosphere protection devices used at the subsequent stages of the technological processes at KGHM are presented below.

Limitation of dust emission

Ore crushing plants have been equipped with two-stage draught-dedusting unit systems composed of cyclones and impact scrubbers.

In 2000-2001 dedusting systems were replaced in three out of six crushing plants. New filters are going to be installed in the remaining ones by the end of 2005.

Drying facilities at the Ore Enrichment Plants are equipped with wet dedusting systems based on impact scrubbers. The drying facility at "Glogow I" is equipped with Venturi tubes with adjustable throat, while at "Glogow II", where concentrate must be dried more deeply, gas is dedusted in an electrofilter. The newest and the most effective dedusting system, based on bag filters, was installed at "Legnica" works in 1995 and was subsequently modernised in 2000.

In all mills concentrate is unloaded in closed facilities. Local draughts, switched on inside the facilities during the unloading of concentrate, are equipped with very effective bag filters dedusting to the level of below 10 mg/Nm^3.

Briquetting machines and pouring units at "Legnica" and "Glogow I" are equipped with their own local ventilation systems in which gas is dedusted in highly efficient bag filters.

Shaft furnaces are the source of three gas streams, which (with the exception of one at "Legnica") have been totally eliminated.

The stream of process gas leaving shaft furnaces is dedusted in cyclones and then undergoes wet treatment to reach 60 mg/Nm^3 in Venturi tubes with adjustable throat. After dedusting, gas is burnt in local heat and power generating plants and further treated together with exhaust gas.

The two remaining streams of polluted gas are streams of ventilation gas from the shaft furnace feeding area and the tapping area. Currently all the gas from the tapping area of "Legnica" and "Glogow I" (referred to as lean gas) is dedusted in highly efficient bag filters to the level of below 10 mg/Nm^3, and then used as an air blast in heat and power generating plants. Gas from the feeding of shaft furnaces in both mills is dedusted in cassette filters to the level of below 10 mg/Nm^3, and is subsequently directed to the shaft furnaces as a blast at "Glogow I" and emitted to the atmosphere at "Legnica".

Converters at "Legnica" and "Glogow I" as well as the fluidised-bed furnace at "Glogow II" are sources of the main streams of gas containing sulphur dioxide, which is used in sulphuric acid manufacturing plants. The gas leaving furnaces is dedusted in dry electrolytes, cooled, wet-treated in Swemco columns and wet electrofilters, and subsequently delivered to the contact units. In 1997-1999

the two existing electrofilters dedusting gas from the fluidised-bed furnace at “Glogow II” were rebuilt. In 1999-2000 the system of collection of dust from the converter duster in "Legnica" was hermetised, and in 2001 the gas washing and cooling system was put into operation.

The electric furnace at “Glogow II” discharges gas which does not contain significant amounts of sulphur dioxide. It is dedusted in a bag filter and directed to the atmosphere.

Converters at “Glogow II” discharge gas which does not contain significant amounts of sulphur dioxide. It is wet-treated in Venturi tube and emitted to the atmosphere.

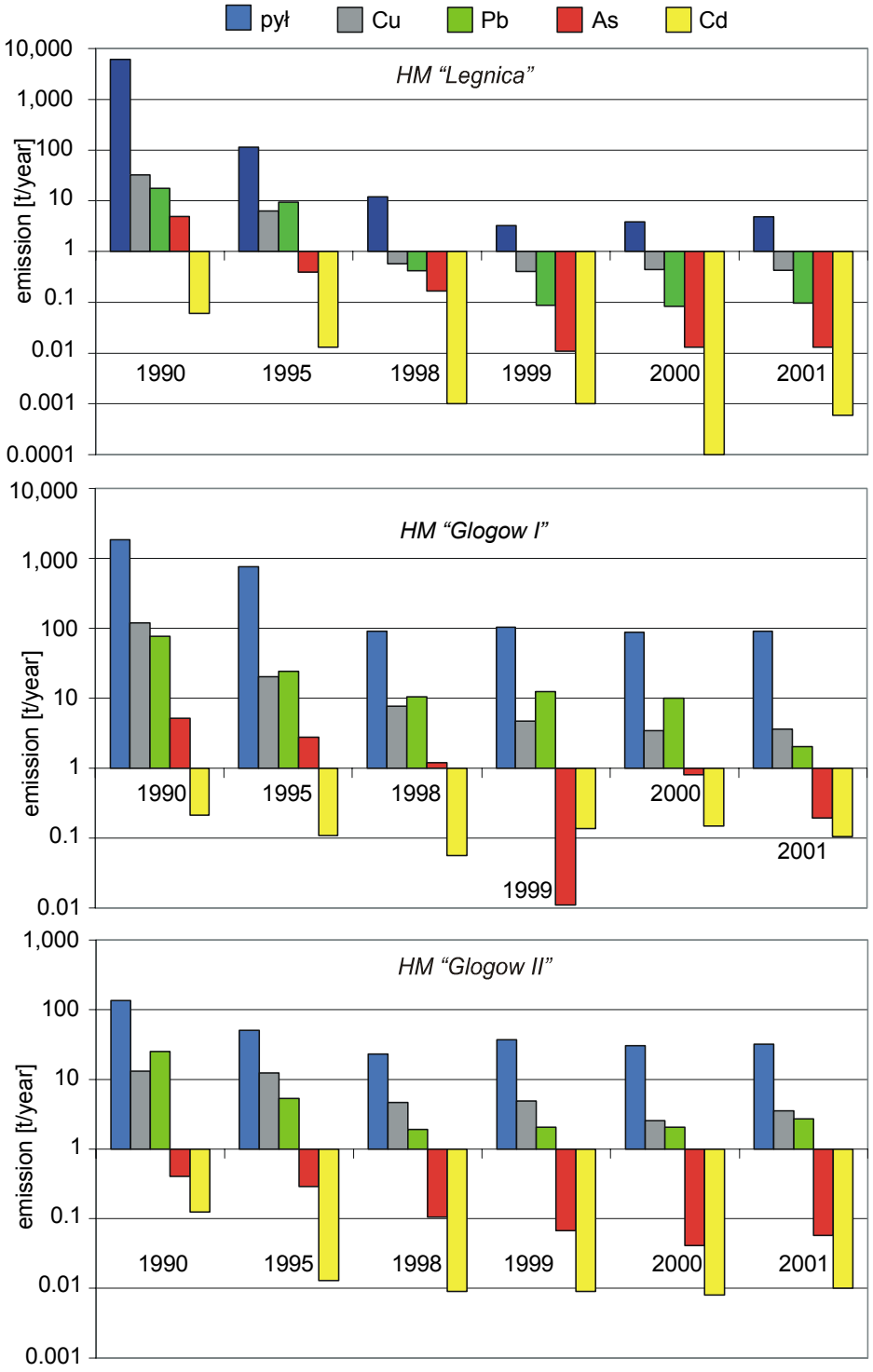
Until 2000, the lead unit of “Glogow I” discharged gas from Dorschel furnaces after wet dusting in Venturi tube. In 2000-2001 the branch was modernised, which included the erection of new furnaces and a much more efficient bag filter duster, from which the entire gas stream was directed to a system removing sulphur from exhaust gas in the heat and power generating plant. In this way the emission from the technological line of the lead branch was entirely liquidated, and at the same time the emission of lead from KGHM was decreased by 62 %. Ventilation gas from the lead unit has been dedusted in a high-performance bag filter (to several mg/Nm^3) since 1996.

Dedusting at the heat and power generating plant operating at both mills is carried out by the sulphur removing systems. At “Legnica” the system is preceded with heavy-duty electrofilters and washing columns, and at “Glogow I” the product of neutralisation is collected by bag filters.

The consistent upgrading of the copper manufacture technology and environmental protection devices has resulted in a significant lowering of emissions of all dust pollutants from the mills of KGHM, as specified in the table below.

Table 60. Emission of dust pollutants from “Legnica”, “Glogow I” and “Glogow II” copper works in 1990 – 2001.

KGHM works	Pollutant	Emission [tons/year]					
		1990	**1995**	**1998**	**1999**	**2000**	**2001**
“Legnica” Copper Works	Dust	6,067	114	12	3.24	3.85	4.84
	Cu	32.6	6.3	0.57	0.405	0.438	0.428
	Pb	17.6	9.4	0.42	0.088	0.083	0.097
	As	4.9	0.39	0.167	0.011	0.013	0.013
	Cd	0.06	0.013	0.001	0.001	0.0001	0.0006
“Glogow I” Copper Works	dust	1,881	763	95	107.53	88.51	93.28
	Cu	118.2	20.5	7.73	4.636	3.49	3.704
	Pb	76.6	24.7	10.34	12.604	10.24	2.04
	As	5.211	2.765	1.213	0.011	0.811	0.196
	Cd	0.215	0.106	0.055	0.137	0.1477	0.105
“Glogow II” Copper Works	dust	136	50	23	37	30.31	31.91
	Cu	13	12.2	4.65	4.867	2.533	3.499
	Pb	25	5.3	1.9	2.048	2.064	2.726
	As	0.405	0.288	0.105	0.067	0.041	0.058
	Cd	0.125	0.013	0.009	0.009	0.008	0.01



Figures 23 – 25
Emission of dust pollutants [logarithmic scale used] from "Legnica" Copper Works, "Glogow I" Copper Works and "Glogow II" Copper Works.

Reduction in gas emissions

Mines and Ore Enrichment Plants never posed a significant threat with gas emission. The drying plants use natural gas and therefore they do not emit sulphur dioxide.

Gas from the shaft furnaces used at "Legnica" and "Glogow" contains approx. 10 % of CO, from a few to a dozen or so g/Nm^3 of SO_2 and several g/Nm^3 of CS_2. After wet dusting it is directed to the heat and power generating plants (in both mills) and burnt as an additional fuel next to coal. Sulphur is removed from the exhaust gas from both plants.

In 1997 in order to eliminate the non-organised gas emission from metallurgical units of "Legnica" and "Glogow I" the dedusted ventilation gas was directed from the tapping area of shaft furnaces to the heat and power generating plants as an air blast for the furnaces. For the same purpose the dedusted ventilation gas from the area of the feeding of shaft furnaces at "Glogow I" was returned as an air blast to the furnaces. This solution will also be used at "Legnica".

The gas from the fluidised-bed furnace at "Glogow II" does not contain carbon oxide, and the stable SO_2 content (6-8 %) enables complete recycling at the sulphuric acid manufacturing factory with the use of a double conversion process.

Converter gas at "Legnica" and "Glogow I" contain the main load of sulphur dioxide, which is released in pyrometallurgical copper manufacture. It is recycled in high-performance (above 98%) sulphuric acid manufacturing factories.

Converter gas from "Glogow II" does not contain significant amounts of SO_2 and after wet dedusting in Venturi tubes it is discharged to the atmosphere.

Gas from anode furnaces contains some sulphur dioxide, depending on the heat stage. Due to the high temperature of the gas, it was only in recent years that it was possible to measure the amounts and assess the emission of SO_2 at the level from several to a few hundred tons/year. At "Glogow I" gas treatment plant was erected and put into operation in 2000 following the replacement of two stationary anode furnaces with the rotary ones (in 1998-2000). Semi-dry technology with milk of lime and the collection of the dry product in bag filters was used (this is the same technology which has been used since 1997 at "Glogow I" for the removal of sulphur dioxide from the heat and power generating plant exhaust gas). A similar gas treatment plant is being built at "Glogow II". The investment project will be completed this year. A similar treatment plant will be erected at "Legnica".

At the end of 2000, all technological gas was directed, after dedusting, to the gas desulphurisation system at the heat and power generating plant. Since 2001 the unit emits only dedusted ventilation gas from the tipping areas.

The heat and power generating plants localised by "Legnica" and "Glogow I" use not only coal, but also the shaft gas producing 70 % of sulphur dioxide contained in the exhaust gas. That is why exhaust gas is desulphurised at both plants. Since 1994 "Legnica" has a sulphur removal system based on the Solinox process. It receives and desulphurises tail gas from the sulphuric acid manufacturing factory. The sulphur removal technology is based on the selective physical absorption of sulphur dioxide in a liquid organic solvent, which is totally reworked, and the sulphur dioxide recovered during the reworking is returned to the sulphuric acid manufacturing plant. The contents of SO_2 in the gas leaving

the system does not exceed 0.25 g/Nm^3. The exhaust gas desulphurisation system at "Glogow I" uses the semi-dry method and was erected and put into operation in 1997. It receives approx. 1 million Nm^3/h of exhaust gas containing 1-5 g/Nm^3 of SO_2, which is absorbable in a $Ca(OH)_2$ suspension. Water from the suspension sprayed in the columns, through which the desulphurised gas goes, evaporates in full and the dry product is collected in bag filters. Clean gas contains below 0.8 g/Nm^3 SO_2, and the product of desulphurisation a dozen or so percent of lime. Since 2000 the system also receives all technological gas from the lead unit in the amount of 60,000 $Nm^{3/}$h.

Waste management

Produced in the amount of approx. 1.2 million tons/year, non-organic wastes generated in the course of thermal processes constitute the biggest group of wastes at "Glogow I" and "Glogow II" and "Legnica" copper works. Waste management at KGHM is consistent with the Polish regulations in force, which determine the handling of waste and treat recycling as a priority. This priority applies to the majority of wastes produced at the mills.

The slag produced during the heat of copper in shift furnaces is used for the manufacture of road aggregate. In 1996 KGHM obtained a technical approval for the broken aggregate from the material. Additionally, slag is also used for the reclamation of post-industrial land (*e.g.* land remaining after sand or clay mines).

After granulation, slag from the electric furnace of "Glogow II" is used as an ingredient of floor material used for the filling of underground headings in copper mines. Owing to its hardness, it is also used for the shot blasting cleaning of metal elements, replacing quartzite sand. Other types of slag produced during the mill processes are returned to the process.

Lead-bearing dust and slime collected in dust collectors at all three copper mills is processed to become crude lead at "Glogow I". Until 2000, due to a limited throughput of the Dorschel furnaces, some lead-bearing slime from shaft gas dedusting systems had to be stored. In 2000 two Dorshel furnaces were replaced with two modern rocking-rotary furnaces with oxygen enriched blow. The efficiency of each of the furnaces is more than twice as big as the efficiency of the previous furnaces. In mid-2001 the third furnace (of the same size) was erected and put into operation. The lead unit is already able to receive on a regular basis dust and slime collected in dust collectors at the three copper mills, and to gradually process the slime collected in the past. The gas from the furnaces after being dedusted in a bag filter, is directed to the desulphurisation system at the heat and power generating plant. In this way the problem of the storage of some lead-bearing slime has been solved for KGHM. Additionally, the main emitter of lead to the atmosphere (70 % of lead emission from KGHM) was liquidated and the emission of sulphur dioxide from the same unit was also stopped.

Ecological investment projects

Conscious of its responsibility for the natural environment, KGHM has been implementing a programme of ecological investment projects for which more than EUR 125 million were designated in 1991 – 2000. As a result the degree of noxiousness of the copper industry in the scope of emission of hazardous substances, effluents and production waste was limited to the level reached by the most modern companies. In the period in question the environmental investment outlays incurred by KGHM constituted from a dozen or so to thirty five percent of all the investment outlays of the company.

Table 61. Investment outlays of projects over the years.

Year	Investment outlays [millions of EUR]
1991	10.5
1992	14
1993	11.5
1994	10
1995	2.9
1996	16.3
1997	41.2
1998	6.4* + 7.2**
1999	7.5* + 15.3**
2000	9.4* + 83.3**
2001	14.4* + 20.8**
Total in 1991-2001	**141.7* + 60.2****

* investment projects with environmental priority

** with another priority

Conclusions

In many countries the non-ferrous metals mining industry is localised in uninhabited areas or in areas with very small number of inhabitants. KGHM Polish Copper was established in an agricultural area close to urban agglomerations. This localisation of mines and mills, combined with a growing ecological awareness in Poland and all over the world as well as more and more stringent ecological regulations, were the main factors behind the ecological policy followed by the company for many years. Continuous technical progress makes it possible to implement the programmes prepared. Some techniques were adapted from the "list" of world achievements, but also numerous original solutions were implemented, which were adjusted to the type of ore and the specific requirements of the industry.

In 2000 both copper mills were deleted from the “List of 80” most noxious plants in Poland. At the moment the level of noxiousness of KGHM is limited to the current boundaries of technical and economic possibilities. The technologies used in basic processes as well as the environment protection techniques meet international BAT standards. The emission to the atmosphere, waste management, water supply and sewage disposal in all three mills are finally consistent with the standards provided under the Polish law and are much below the levels recommended by the Helsinki Convention. Despite the fact that some of the environment protection solutions adopted may be considered final, the concern’s policy focuses on further changes aimed at decreasing its environmental impact and at improvement in the technologies used, as reflected in the investment projects which have already been commenced and the ones which are planned.

“Ubocz” Phosphate Fertiliser Plant in Gryfow Slaski - Hot Spot No. 105

The “Ubocz” Phosphate Fertiliser Plant produces superphosphate. The production does not generate wastes and sewage. Domestic wastewater and – due to the past activities – infiltration waters

containing heavy metals, amounting all together to 12,000 m^3 in 2000, are treated by means of the Imhoff tank. The sludge is utilised by the municipal wastewater treatment plant in Gryfow Slaski.

Investment activities in the years 1980-1990 and changes in production in the years 1990-2000 resulted in constant improvement of the infiltration water quality. The most polluted part of the waters is utilised in the superphosphate production process.

Concentrations of heavy metals in treated wastewater do not exceed the limit values defined in HELCOM Recommendation 23/11. As the heavy metal concentrations do not result from the production, each increase of production would result in reducing these metal concentrations.

The maximum specific cadmium discharges from the production are 0.08 kg/ton. The fertiliser does not contain mercury. The production has been reduced from 40,000 tons in 1989 to 4,000 in 2000. The chemical processes have been reduced in favour of the physical ones (mixing, granulation).

"Wizow" Chemical Plant in Boleslawiec – Hot Spot No. 106

General description

"Wizow" in Boleslawiec started its activity in 1951 from the manufacture of sulphuric acid, clinker and Portland cement. In 1969 the manufacture of phosphoric acid and phosphorous salts was started. Until 1981 "Wizow" was the only Polish manufacturer of pentasodium triphosphate – the basic raw material for the household chemistry. The plant remains a domestic monopolist in the manufacture of crystalline sodium phosphates and 1-ammonium phosphate. The "Alwernia" Chemical Plant is its only competitor in the manufacture of pentasodium triphosphate.

The final products manufactured include pure, crystalline phosphorous salts and special types of cement. Production capacity amounts to 43,000 tons a year. At the moment the following manufacturing departments are functioning at the Plant:

- Phosphoric Acid and Phosphorous Salts Unit, which manufactures:
  - extracted phosphoric acid from apatite,
  - pentasodium triphosphate;
- Cement and Mineral Raw Materials Milling Unit, which manufactures high-quality cement types designed for special purposes.

Water and wastewater management

Since 1989 the wastewater from the phosphoric acid and phosphorous salt manufacturing plant has been treated in the new treatment plant. Improvements and intensification of the wastewater treatment process resulted in the reduction in the phosphate loads discharged to the Bobr River to 1 ton a year. However, the wastewater treatment technology used did not allow a satisfactory reduction in phosphates and fluorides. Due to this, a further programme of rationalisation of water intake and recycling of wastewater has been implemented.

Wastewater produced during technological processes and during the removal of fluorine from the exhaust gas is treated in the modernised chemical treatment plant. It is first neutralised with the lime milk and then directed to the sludge lagoon, where deposition of pollutants takes place. Both the over-

sludge fluid and the treated water are returned to the manufacturing process and to the fluorine gas cleaning equipment.

As a result of the use of closed process water circulation, there has been a 97 % decrease in the intake of water and discharge of wastewater. Also, the following pollutant reduction levels have been reached in the wastewater discharged to the Bobr River:

- 99.9 % reduction of the phosphate and fluoride load;
- 99.9 % reduction in the load of sulphates and suspended matter;
- a reduction of the phosphorus specific load discharged in the wastewater from 15.6 kg P/t P_2O_5 to 0.023 kg P/t P_2O_5 produced.

Table 62. Amount of water intake and wastewater produced and discharged in connection with the Plant activity.

	Water intake	**Wastewater discharged**	**Total phosphorus**		**Fluorides**	
	[10^3 m^3]	**[10^3 m^3]**	**kg P/ year**	**kg P/t P_2O_5**	**kg F/year**	**kg P/t P_2O_5**
2001	156	139	737	0.026	57	0.002
1st half of 2002	64	61	298	0.023	15	0.001

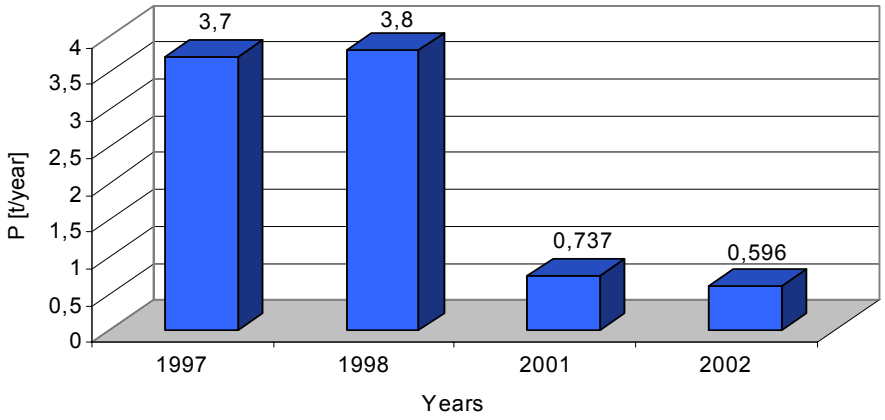


Figure 26. Total load of phosphorus discharged from the Plant over the years.

*Data for 2002 based on forecasts and pollutant volumes discharged in the first half of the year.

According to the production profile the plant does not use heavy metals and their compounds for technological purposes and therefore these pollutants are not discharged to the receiving water bodies. In any case, should heavy metals be detected in discharged wastewater, this contamination may come only from the pollution of the water uptaken for technological purposes and the concentration is negligible.

Emissions to the atmosphere

In 1991-1993 three systems cleaning exhaust gas from the manufacture of phosphoric acid and absorbing fluorides were installed in the Plant. Their current efficiency reaches 92 %, which has led to a reduction in fluorine emissions from 8 to 0.9 t/year.

In the phosphoric acid manufacturing process, during the decomposition of apatite, fluorine is released in the form a gaseous silicon tetrafluoride. All the technological points in which vapours containing fluorine compounds are present are equipped with fluidal scrubbers, in which the gas emitted to the atmosphere is cleaned. The technological points emitting phosphate dust are also equipped with wet scrubbers.

Table 63. The emission of fluorine compounds and dust in comparison with limit values set in HELCOM Recommendation 17/6.

Parameters		Reached by the plant		Required by HELCOM
		2001	1st half of 2002	
Fluorides	kg F/year	900	426	—
	mg/m^3	n.d.	0.87	5
Dust	kg/year	13,000	6,338	—
	mg/m^3	30.1	29.8	50

Waste Management

The basic waste streams generated in the manufacturing process include:

- phosphogypsum;
- sodium fluosilicate;
- neutralisation sludge.

Phosphogypsum is the main waste stream generated in the manufacturing process. Due to limited possibilities for its recycling, practically almost all of it is disposed of at the company landfill site. The landfill site belonging to the Plant has an insulated bed and is equipped with a drainage system handling the surface flow and the leakage. The system of band ditches directs surplus water to the evaporation tanks, where it is kept until it evaporates naturally. If there is too much surplus water, it is directed to the company industrial wastewater treatment plant.

Phosphogypsum produced in the technological process has increased bonding properties, which eliminates dust emissions to the environment. Land reclamation involving afforestation is regularly carried out on the surface of the heap slopes. The Plant uses approx. 1 % of the waste for commercial purposes, which is similar to the results achieved in other countries.

Sodium fluosilicate and neutralisation sludge are disposed of at sludge lagoons. At the moment two sludge lagoons are used, which results from the requirements of technological processes and the use of closed process water circulation, as the lagoons are simultaneously used as industrial water reservoirs.

The bed and the walls of the sludge lagoons are insulated with a double layer of benthomat and HDPE geomembrane. Approx. 25 % of the neutralisation sludge is used for the manufacture of mineral fertilisers.

The network of piezometers installed in the sludge lagoon and phosphogypsum landfill site area makes it possible to closely monitor the impact of waste on groundwater. Analysis of water quality monitoring data, which has been carried out since 1992, shows a stable decrease in the concentration of pollutants. This is a result of:

- rationalisation of water and wastewater management;
- silting of the lagoon bed and drying of sludge in the lagoon which is no longer used;
- insulation of the bed of the landfill site and sludge lagoons currently used.

In 2001 the plant produced 117,244 tons of waste (incl. 14,500 tons of hazardous waste). Out of this amount, 111,910 tons of non-hazardous waste were disposed of at landfill. All the hazardous waste and 5,319 tons of non-hazardous waste were further used.

Environmental investment projects

Since the beginning of 1980s, "Wizow" has been undertaking intensive steps aimed at the reduction of environmental nuisance.

In 1983-1986 the exhaust gas dedusting systems of three drying plants and three raw material mills were modernised. Installation of modern dedusting devices, backward cyclones with 92 % efficiency, resulted in a fourfold reduction in the emission of dust to the atmosphere.

In the mid-eighties (1986) the manufacture of sulphuric acid was reduced by 50 % of the production capacity. One of the production lines was closed and the operating line was thoroughly repaired. Although the emission of sulphur dioxide to the atmosphere was reduced fivefold, the manufacturing plant still constituted an environmental nuisance.

The erection of three sulphuric acid storage tanks with the total capacity of 10,000 m^3 (16,000 tons), made it possible to stop the manufacture of the acid on 2 April 1990. The liquidation of the sulphur plant resulted in a 90 % decrease in the emission of dust (to 100 tons/year), and a 70 % decrease in sulphur dioxide (to 340 tons/year).

The modernisation of systems and technological processes made it possible for the Plant to meet the quality standard requirements and seriously contributed to an improvement in the condition of the natural environment.

Under a programme of the limitation of production and environmental nuisance adopted in 1992, the following projects have been implemented:

- Closed process water circulation was introduced, which caused a 97 % decrease in the amount of water drawn from the Bobr River and a 99.9 % reduction in the load of phosphorus discharged in wastewater.
- Filter-presses were installed in the technological line used for the manufacture of pentasodium triphosphate, which made it possible to use neutralisation sludge for the manufacture of mineral fertilisers.
- High-performance fluidal scrubbers, guaranteeing the maintenance of permissible emission levels were installed at all the fluorine compound and dust emitting technological points, and the area

around technological devices was insulated to protect against infiltration of pollutants to the groundwater.

- A network of piezometers was installed to facilitate the monitoring of groundwater in the area of sludge lagoons and the phosphogypsum heap.
- A new phosphogypsum landfill site was built, complete with bed insulation, and a network of band ditches and evaporation tanks.
- Two new sludge lagoons with double bed and wall insulation were built and a monitoring system was installed facilitating the control of the functioning of the facilities and protecting against contamination of soil and groundwater.
- In 1999 the brown-coal fuelled company heat and power generation plant was closed, which made it possible to eliminate the emission of sulphur oxides, dust and nitric oxides to the atmosphere.

Conclusions

Today, the "Wizow" Plant's environmental impact is consistent with the standards in force and the Plant has all the required documents and permits in this scope.

In order to maintain the correct water and wastewater management, "Wizow" uses a closed process water circulation system in the manufacture of phosphoric acid and phosphorous salt. The water and wastewater management system implemented at the Plant has limited raw material losses and has caused a reduction in the intake of water and discharge of wastewater to the Bobr River. Industrial water in closed circulation is treated in the company wastewater treatment plant. The wastewater is neutralised with the lime milk and further directed to sludge lagoons, in which pollutants (phosphates and fluorides) are precipitated. Over-sludge water is returned to technological processes.

According to data for 2001 and the first quarter of 2002, the load of phosphates in the wastewater discharged to surface water amounted to 0.026–0.023 kg P/ t of P_2O_5 and pentasodium triphosphate manufactured, which is consistent with HELCOM Recommendation 17/6 for assortment C.

Gas discharged in the technological processes and polluted with dust and fluorides is cleaned in wet and fluidal scrubbers equipped with high-performance dephlegmators, facilitating the maintenance of boundary values for:

- dust - 30 mg/m^3
- fluorine compounds – below 5 mg F/m^3.

As far as possible, the wastes produced at "Wizow" are used for industrial purposes. Only phosphogypsum is disposed of at the landfill site almost in total. Owing to the systematic reclamation of the phosphogypsum heap slopes, the heap is becoming a part of the landscape.

Hot Spot No. 81.2 - Pulp and Paper Mill in Wloclawek (air pollution, treatment of municipal and industrial wastewater) and **Hot Spot No. 98.3 - P.P.U "Gryf" in Szczecin** (wastewater treatment, wastes management) are industries removed from the List due to closing down of the plants.

LIST OF LEGAL INSTRUMENTS RELEVANT TO THE HOT SPOTS

1. Water Law of 18 July 2001.
2. Collective water supply and collective sewage disposal Act of 7 June 2001.
3. Packages and package wastes Act of 11 May 2001.
4. Wastes Act of 27 April 2001.
5. Environment Protection Law of 27 April 2001.
6. Access to the information relating to the environment, its protection and environmental impact assessment Act of 9 November 2000.
7. Marine areas of the Polish Republic and maritime administration Act of 21 March 1991.
8. UN/ECE Convention on Access to Information and Public Participation (Aarhus Convention) of 1 April 1998.
9. Convention on the Protection of the Marine Environment of the Baltic Sea Area of 4 April 1992.

ATTACHMENT 1

List of Polish JCP Hot Spots in Force

No.	Status	Location	Name	Pollution problems	Hot spot type	Catchment	Distance from the sea
73	P		Vistula Lagoon	Environmental Management Programme	Municipal, industrial, agricultural	Lagoon/Baltic	<100
74	P	Koszalin	"Jamno" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Baltic	<100
82		Warszawa	"Czajka" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<600
83.1	P	Warszawa	"Poludnie" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<600
84		Warszawa	"Pancerz" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<600
85		Lublin	"Hajdow" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<600
86	P	Krakow	"Plaszow" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<900
87.1	P	Krakow	"Kujawy" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula	<900
87.2	P	Krakow	"Tadeusz Sendzimir" Steel Plant	Air pollution, waste management	Industry	Vistula	<900
88.1	P	Katowice Area – Bytom, Radzionkow	Bytom Municipal Enterprise	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula /Odra	<600
88.2	P	Katowice Area – Gliwice	Waterworks & Sewerage Enterprise	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula /Odra	<600
88.3	P	Katowice Area – Katowice, Myslowice, Siemianowice	Regional Enterprise of Waterworks and Sewerage	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula /Odra	<600
88.4	P	Katowice Area – Tychy	Regional Centre of Water and Wastewater Management	Treatment of municipal and industrial wastewater	Municipal, industrial	Vistula/Odra	<600
88.5	P	Katowice Area – Bytom	„Duo-Stal" Ltd.	Air pollution	Industry	Vistula /Odra	<600

88.6	P	Katowice Area – Dabrowa Gornicza	"Katowice" Steel Plant	Air pollution, waste management	Industry	Vistula /Odra	<600
88.7	P	Katowice Area – Czechowice-Dziedzice	"Czechowice" Refinery	Wastewater treatment, air pollution, waste management	Industry	Vistula /Odra	<600
88.8	P	Katowice Area – Dabrowa Gornicza	"Przyjazn" Coking Plant	Air pollution, wastewater treatment	Industry	Vistula /Odra	<600
89		Jaworzno	"Organika-Azot" Chemical Plants	Wastewater treatment, air pollution, waste management	Industry	Vistula	<900
95	P	Vistula catchment	Agriculture and livestock farming	Agriculture runoff programme	Agriculture	Vistula	-
97.1	P	Szczecin	"Pomorzany" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Baltic/Lagoon	<100
97.2	P	Szczecin	"Zdroje" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Baltic/Lagoon	<100
98.2	P	Szczecin	"Szczecin-Skolwin" Paper Mill	Wastewater treatment, air pollution	Industry	Baltic/Lagoon	<100
99.2		Poznan	"Left River Bank" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Odra	<600
100	P	Lodz	"Group" Wastewater Treatment Plant	Municipal wastewater treatment	Municipal	Odra	<900
103		Wroclaw	Wroclaw Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Odra	<600
104		Brzeg Dolny	"Rokita" Chemical Plants	Wastewater treatment, heavy metals	Industry	Odra	<600
107	P	Katowice Western area	**See Hot Spot no. 88**			Odra	<600
108	P	Katowice Western Area	**See Hot Spot no. 88**			Odra	<600
112	P	Odra cachtment	Agriculture and livestock farming	Agriculture runoff programme	Agriculture	Odra	-
113	P		Szczecinski Lagoon	Environmental Management Programme	Municipal, industry, agriculture	Vistula/Baltic	<100

P - priority hot spot

List of Polish Hot Spots deleted from the JCP List

No.	Status	Location	Name	Pollution problems	Hot spot type	Catchment	Distance from the sea
75	P	Gdynia	"Debogorze" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Baltic	<100
76.1	P	Gdansk	"Wschod" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal	Baltic	<100
76.2	P	Gdansk	Gdansk Refinery	Waste management, oil combating	Industry	Baltic	<100
77		Swiecie	Frantschach Swiecie – Pulp and Paper Mill	Wastewater treatment, air pollution, wastes management	Industry	Vistula	<300
78	P	Bydgoszcz	"Fordon" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Vistula	<300
79		Bydgoszcz	"Kapusciska" Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Vistula	<300
80	P	Torun	Torun Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Vistula	<300
81.1	P	Wloclawek	"Anwil" Nitric Plants	Air pollution, treatment of municipal and industrial wastewater	Industry	Vistula	<600
81.2	P	Wloclawek	Pulp and Paper Mill	Air pollution, treatment of municipal and industrial wastewater	Industry	Vistula	<600
83.2	P	Warszawa	"Siekierki" Heat and Power Plant	Air pollution	Industry	Vistula	<600
90		Zgierz	"Boruta" Dyestuff Industry Works	Wastewater treatment	Industry	Vistula	<900
91		Oswiecim	"Dwory" Chemical Plant	Wastewater treatment, air pollution	Industry	Vistula	<900
92		Bukowno	"Bolesław" Mining and Metallurgic Works	Wastewater treatment, air pollution, wastes management	Industry	Vistula	<1200
96		Upper Vistula Basin	Coal mines discharging mining water	Salt control	Industry	Vistula	<1200
98.1	P	Police	"Police" Chemical Plants	Wastewater treatment, air pollution, waste management	Industry	Odra	<100
98.3	P	Szczecin	"Gryf" P.P.U.	Wastewater treatment, waste management	Industry	Odra	<100
99.1		Poznan	"Central" Wastewater Treatment Plant	Treatment of municipal wastewater	Municipal	Odra	<600
101		Zielona Gora	Zielona Gora Wastewater Treatment Plant	Treatment of municipal and industrial wastewater	Municipal, industry	Odra	<600

102.1	P	Prochowice	"Prochowickie" Poultry Processing Plants	Wastewater treatment	Industry	Odra	<600
102.2	P	Zukowice	KGHM "Polish Copper" - Copper Works "Głogow"	Wastewater treatment (heavy metals), air pollution, waste management	Industry	Odra	<600
102.3	P	Legnica	KGHM "Polish Copper" - Copper Works "Legnica"	Wastewater treatment (heavy metals), air pollution, waste management	Industry	Odra	<600
105		Gryfow Slaski	"Ubocz" Phosphate Fertiliser Plant	Wastewater treatment, heavy metals	Industry	Odra	<600
106		Boleslawiec	"Wizow" Chemical Plants	Wastewater treatment	Industry	Odra	<600
111		Upper Odra Basin	Coal mines discharging mining water	Salt control	Industry	Odra	<600

Hot Spots Nos. 81.2, 98.3 – deleted in 1996.
Hot Spots Nos. 76.1, 80 – deleted in January 2001 according to the decision of the PITF.
Hot Spots No. 105 – deleted in November 2001 according to the decision of the 18th Meeting of the PITF.
Hot Spots Nos. 75, 77, 78, 79, 90, 91, 92, 96, 99.1, 111 – deleted in May 2002 according to the decision taken by the 18th Meeting of the PITF.
Hot Spots Nos. 76.2, 81.1, 83.2, 98.1, 101, 102.1, 102.2, 102.3, 106 – deleted in November 2002 according to the decision taken by the 19th Meeting of the PITF.

ATTACHMENT 2

Polish JCP Hot Spots –Timetable for deletion

Hot Spot name	Environmental impact	Projects planned/in course of implementation	Necessary actions	Proposed date for commencement of hot spot deletion procedure
Vistula Lagoon Hot Spot No. 73	Transboundary area. The biggest cities within the catchment area are: Kaliningrad (Russia), Olsztyn and Elblag (Poland). The lagoon catchment area (23,871 km^2) is about 30 times larger than the lagoon itself. In the Polish part of the Vistula Lagoon coastal area 2 landscape parks are established. Municipal wastewater management in the Polish part does not raise any objections. Main source of pollution is load discharged via rivers. Main problems affecting the Vistula Lagoon area on the Polish side are: • eutrophication; • excessive concentration of tourism on the Vistula Spit; • flood hazard. The idea of integrated management is complicated due to the structure of public administration (2 provinces) and division between 2 countries. Lack of explicit criteria makes it impossible to determine timeframes/date for deletion from the JCP Hot Spot List.			
"Jamno" WWTP in Koszalin Hot Spot No. 74	Mechanical-biological WWTP with chemically supported phosphorus reduction with capacity of 40,000 m^3/d. Whole city population served (120,000 inhabitants, 32,000 m^3/d). Sewerage system covers 90 % of the city area. Average 24-h pollution concentration in treated wastewater [mg/l] and reduction (%) as of 25/26 June 2002: BOD_5 – 2.75 (99 %) COD – 16.1 (98 %) N-tot – 9.75 (91 %) P-tot – 0.28 (98 %). Sludge amount – 10,000 t/year (25 % d.w.); disposed of at municipal landfill. The quality of sludge is good enough to make possible its use for agricultural purposes. In coming years landfill operator plans to start compost production from the sludge.	Modernisation (development of biological stage to enhance nitrogen reduction) finished. Start-up is planned to be completed in December 2002.	Relevant HELCOM Recs. met.	December 2002
Gdansk Refinery Hot Spot No. 76.2	Business profile results in emission of gaseous pollution to the air (SO_2, NO_x, CO, methylene chloride, 1,2-dichloroethane, benzo-a-pirene, aliphatic and aromatic hydrocarbons, xylene, butanol, hydrogen sulfide, dust), wastes generation, including hazardous, and wastewater discharge. In 2001, 99 % of generated wastes were used or rendered harmless, half of disposed wastes (1 %) constituted municipal wastes.		ISO 14001 System of Environmental Management implemented. Relevant HELCOM Recs. met BAT introduced.	October 2002 *(Deleted)*

Gdansk Refinery Hot Spot No. 76.2 – continued	Refinery is equipped with 3-stage mechanical-biological-chemical WWTP, which is supplied with 5 separate sewerage systems (technological, oil-contaminated, sanitation, drainage and rain-water). Depending on the contamination, streams of wastewater are treated appropriately. Cooling water system is closed. In 2001 44 % of treated wastewater was re-used by the Refinery. Since 2000 the petrol manufactured at the plant contains no lead and the diesel oil has low sulphur content.			
"Anwil" Nitric Plant in Wloclawek Hot Spot No. 81.1	Chemical plant producing organic and inorganic products for the processing industry (PVC, caustic soda and soda lye) and for agriculture (saltpetre, nitro-chalk). An impact on the environment relates to the pollution load in wastewater (COD, N, chlorides, sulphides, heavy metals), emission to the air (dust, vinyl chloride, carbon tetrachloride, aliphatic and aromatic hydrocarbons, ammonia), and wastes generation, mainly hazardous. In 2001: - 86 % of generated wastes (hazardous) were reused in the plant, - 6,2 % provided to third parties, - 7,3 % disposed of at company landfill sites (including only 0,5 % of hazardous wastes). Wastewater is pre-treated in plant before discharging to municipal WWTP.	Modernisation of wastewater management is ongoing.	Requirements of the HELCOM Recs. are met.	2002 *(Deleted)*
"Czajka" WWTP in Warsaw Hot Spot No. 82	Mechanical-biological WWTP serving the East-bank part of Warsaw (500,000 inhabitants, 31 % of population). Industrial wastewater makes 12 % of inflow. Designed capacity 400,000 m^3/d, actual inflow below 220,000 m^3/d. Annual average pollution concentration [mg/l] and reduction (%) as of 2001: BOD_5 – 12 (93.9 %) COD 61 (91.1 %) N-tot – 19.5 (60.7 %) P-tot – 1.34 (88.9 %).	Development and modernisation of WWTP to 500,000 m^3/d capacity. Supply of wastewater from North part of the West-bank Warsaw equipped with combined sewerage system (indicated as Hot Spot No. 84).	Development and modernisation of the plant to enable treatment of wastewater from North-part of the West-bank Warsaw and enhancing the nitrogen reduction.	2009
"Poludnie" WWTP in Warsaw Hot Spot No. 83.1	Wastewater from the southern part of the West-bank Warsaw (25 % of the total city area and population) are not treated at present. Construction of WWTP has already been started. Designed capacity is 112,000 m^3/d, further extension to 224,000 m^3/d possible.	Construction of WWTP in progress. Designed treatment parameters and efficiency in line with the HELCOM Recs. requirements, except for total nitrogen (15 mg N/l at the outlet).	Completion of WWTP construction. Designed technology has to be modified with regard to nitrogen removal (to achieve 10 mg N/l at the outlet).	Second part of 2004

"Siekierki" Heat and Power Plant in Warsaw Hot Spot No. 83.2	Main environmental problems are emission to the air (SO_2, NO_2, CO, dust) and ash deposit. Steam and water boilers are equipped with modern dust collectors (over 99 % de-dusting efficiency). Modern technologies for emission reduction of NO_x (low-emission burners, low-temperature vortex installations on burners) and SO_2 (low-sulphur coal assortments used) are introduced. Level of dust emission is 40 %, NO_x – 80 %, and SO_2 - 65 % of the valid norms. The total volume of ash waste produced (fly-ash and slag) is used in construction and cement industries. Existing ash dump is equipped with a protection zone, watering installation and monitoring of the underground water quality. The Plant posseses own mechanical-chemical WWTP. Proper temperature of dropped cooling water is guaranteed.	Modernisation of steam boiler – installation of a sack filter (99.9 % de-dusting efficiency) and low-emission burners (enabling 45 % NO_x emission reduction). More stringent EU requirements for air emission are to be observed from 2006. To follow these requirements, low-sulphur coal (S content below 0.55 %) is to be used in four unit burners.	Lack of relevant HELCOM Recs. Due to reduction of the impact on the environment the Plant was deleted from the national "Dirty 80 List".	October 2002 *(Deleted)*
"Pancerz" WWTP in Warsaw Hot Spot No. 84	The hot spot covers the area of the Northern part of the West-bank Warsaw. Originally, there were plans to build the "Pancerz" WWTP to serve this part of the city. It was decided to give it up and direct the wastewater from the Northern, combined part of the sewerage of the West-bank Warsaw to WWTP "Czajka" (Hot Spot No. 82).			2009
"Hajdow" WWTP in Lublin Hot Spot No. 85	Mechanical-biological plant serving approx. 400,000 inhabitants (450,000 PE). Designed capacity 165,000 m^3/d, actual inflow 80,000 m^3/d. When modernisation is completed the total capacity will reach 120,000 m^3/d. Average pollution concentration [mg/l] and reduction (%) as of 2001: BOD_5 – 8 (97.7 %) COD – 48 (93.6 %) N-tot – 26.2 (64.1 %) P-tot – 7.4 (21.1 %). Solid waste and sludge disposed of at municipal landfill. Due to high heavy metal contamination, use for agricultural purposes not possible.	Modernisation aimed at enhancement of the nitrogen and phosphorus reduction as well as thermal sludge dewatering.	Modernisation aimed at enhancement of the nitrogen and phosphorus reduction.	2006
"Plaszow" WWTP in Cracow Hot Spot No. 86	The plant is overloaded; certain amount of sewage over 7 000 m^3/h is overflowed without treatment. Average concentration of pollutants [g/m^3] and treatment efficiency (%) as of 2000: BOD_5 - 120 (52 %) COD - 216 (52 %) N-tot - 34.6 (16 %) P-tot - 2.6 (57 %).	Modernisation and extension of the WWTP (ISPA grant) - degree of pollutants reduction will comply with the national law, EU Directive and HELCOM Recommendations.	Modernisation and extension of the WWTP.	January 2007

"Kujawy" WWTP in Cracow Hot Spot No. 87.1	Mechanical-biological treatment with nitrification and de-nitrification processes and biological de-phosphate treatment, with a capacity of 80,000 m^3/d. All parameters are in compliance with the water use permit, requirements of EU Directive and HELCOM Recommendations. Average concentration of pollutants [g/m^3] as of 2001: BOD_5 - 11.8 COD - 22.0 Ntot - 4.4 Ptot - 0.9. Sewage sludge after methane fermentation and dehydration on filter press is transported to disposal sites in Silesia.	II stage of the treatment plant: - extension of the sewage system in the surrounding areas, disposal of the sewage from the west part of city system (reduction of the "Plaszow" WWTP load); - improvement in the stabilisation process; - development of the sedimentation system.	Extension of the sewage system.	January 2003
"Tadeusz Sendzimir" Steel Plant in Cracow Hot Spot No. 87.2	Emission to the air [Mg/year] as of 2000: Dust – 3 259 SO_2 – 6 027 NO_2 – 42 054 CO – 42 054 CnHm – 349. The overall water circulation in the Plant is of the closed type. Most of the generated waste is harmful to the environment (containing oils, heavy metals – Mn, Pb, Cr, Cd, Zn, Ni, Cu, Al, asbestos, phenols, tar substances). Some of the waste is re-used up to 100%. Other waste is disposed at the Plant's landfills.	- Modification of coke-quenching tower construction; - Installation of the combustion gas recirculation at the No. 2 sinter belt; - Modernisation of installation for dust removal; - Modernisation of electrofilters at the no. 2 power boiler; - Construction of devices blowing coal dust into the blast furnaces; - Improvement in the sewage system; - Organisation of new landfills; - Installation of containers for waste similar to the communal waste.	- Implementation of the system for continuous measurement of the emission from the Power House Department; - Implementation of the computer system for the modelling of emitted pollution dispersion in current meteorological conditions; Application of BAT with regard to the reduction of emission and a wastewater quality monitoring system.	*) Due to the radical restructurisation of the steel industry in Poland, the privatisation process and the unsettled position of the Plant as a part of the Polish Steel Plant Holding, there is no possibility to plan new environmental investments and to determine the date for Hot Spot deletion.
Katowice Area Hot Spot No. 88	8 enterprises (sub-hot spots) have been selected from the industrial and municipal enterprises located in the areas covered by the characteristics of the Hot Spots Nos.. 88, 107, 108. An identification of specific "sub-hot spots" will allow the regular control of those enterprises, and setting the requirements to be met, in order to be deleted from the List.			
"Organika-Azot" Chemical Plant in Jaworzno Hot Spot No. 89	Chemical industry. A number of hazardous substances is generated. Negative impact on the environment is caused by the emission of the dust and gaseous pollutants to the air, wastewater discharge and existing unsealed hazardous waste disposal sites. Discharges of hazardous substances to the surface waters:	Laboratory research is conducted to prepare the project for modernisation of the Plant's wastewater treatment technology, particularly with regard to	Reclamation of polluted Plant's area, including elimination of environmental nuisance caused by old unsealed hazardous waste disposal sites - estimated	Not earlier than 2004

"Organika-Azot" Chemical Plant in Jaworzno Hot Spot No. 89 – continued	- due to the polluted Plant's area - norms are exceeded with regard to AOX - 7.06 mg/l; insecticides, including: DDT - 8.48 μg/l HCH - 157.4 μg/l DMDT - 10.3 μg/l - due to unsealed installation - high chlorphenwinphos concentration (697 μg/l).	reduction of pesticides residue concentrations. Pesticide pollutant concentrations, including DDT, exceed the national standards for sewage discharged to the groundwater. It should be underlined that this is mainly the result of past production activities, which caused the pollution of the Plant's area, rather than current methods. The other reason is a partly unsealed waste site. Survey to analyse the ground contamination was conducted (1998-2000).	cost of that programme is about PLN 100 million (EUR 25 million) (without external assistance not possible to be realised by the Plant).	
Agriculture in the Vistula river basin Hot Spot No. 95	The conception of identification of specific areas being the main sources of agricultural run-off is still under elaboration.			
"Pomorzany" WWTP in Szczecin Hot Spot No. 97.1	Non-functional wastewater management system in the city: • not sufficient treatment of the wastewater discharged from the existing mechanical WWTPs; • large part of the city area not equipped with sewerage; • untreated wastewater discharged to Odra River (storm water system used); • bad condition of large part of the sewerage At present 84 % of wastewater generated is discharged to Odra river without any treatment.	Construction of "Pomorzany" mechanical-biological WWTP. Construction of sewerage where needed and modernisation of the existing one. Introduction of an integrated waste management system.	Construction of mechanical-biological WWTP. Construction of sewerage where needed and modernisation of the existing one. Introduction of an integrated waste management system.	2008
"Zdroje" WWTP in Szczecin Hot Spot No. 97.2	The plan of waste and wastewater management modernisation included construction of two WWTPs operating in Szczecin: the bigger "Pomorzany" and smaller one - "Drzetowo". This year the City Council has decided to construct only one plant treating the total wastewater volume from the city (WWTP "Pomorzany" Hot Spot No. 97.1). Additionally, the small mechanical WWTP "Zdroje" with a planned capacity of 18.000 m^3/d will be modernised and extended with a biological part by the year 2007. According to that, the name of the Hot Spot was changed to "Zdroje".			2007
"Police" Chemical Plant Hot Spot No. 98.1	Fertiliser production (fertilisers, titanium white and other chemical products). At present main impact on the environment relates to wastewater discharges (COD, N, P, heavy metals) and emission to the air (NO_x, dust, fluorides). The Plant is served by its own WWTP supplied by the municipal	Reduction of wastewater discharges – installation of vacuum pumps on the concentration unit of the phosphoric acid production. Supply of additional streams of wastewater from the neighbouring	The Plant has received the ISO 9002 and "Responsible Care" Certificates. In acknowledgement of the phosphogipsum management the Plant was certified by the	October 2002 *(Deleted)*

"Police" Chemical Plant Hot Spot No. 98.1 – continued	wastewater from the city of Police as well. Wastewater-free fertiliser production. Phosphogipsum is disposed of at the Plant's landfill managed in an appropriate way.	settlements.	US EPA Environment Centre. BAT is introduced. Requirements of HELCOM Recs. are met except some spot emitters with regard to dust and fluorides emission in spite of application of all recommended techniques of pollution reduction and treatment.	
"Szczecin-Skolwin" Paper Mill in Szczecin Hot Spot No. 98.2	Packing paper and newsprint production. No pulp production. The Mill is equipped with own WWTP treating industrial wastewater (10,000 m^3/d) and minor amount of the municipal wastewater from the city of Szczecin (2,000 m^3/d). Average pollution concentration [mg/l] as of 2001: BOD_5 – 10.56 COD – 56.83 Suspended matter – 7.46 N-tot – 7.92 P-tot – 0.35.	Construction of the waste paper de-inking unit in progress. It will enable: - production based on recycled paper instead of pulp; - closing of energy-consuming grinder room.	Lack of relevant HELCOM Recs.	2003
"Left River Bank" WWTP in Poznan Hot Spot No. 99.2	Mechanical-chemical plant treats 33 % of total wastewater from the city (67 % of wastewater is treated by the Central WWTP - hot-spot 99.1 deleted from the List). The city is covered with sewerage in 97%. Annual average pollution concentration [mg/l] and reduction (%) as of 2001: BOD_5 – 222,53 (47,08 %) COD – 377,46 (58,56 %) N-tot – 71,72 (13,71 %) P-tot – 3,62 (58,9 %).	Modernisation and extension to a capacity of 50,000 m^3/d (dry weather) and 80,000 m^3/d (rainy weather). Mechanical-biological plant with possibility of chemical support will be constructed. Waste management will be extended with additional instalations.	Modernisation and extension of WWTP in order to meet the requirements.	
"Group" WWTP in Lodz Hot Spot No. 100	Construction of WWTP in progress. WWTP is planned to serve the city of Lodz and neighbouring cities. At present, 99 % of wastewater undergo mechanical treatment and 86 % the biological one. Annual average pollution concentration [mg/l] and reduction (%) as of 2001: BOD_5 – 23.34 (88.9 %) COD – 68.39 (85.2 %) N-tot – 28.83 (43 %) P-tot – 2.64 (64.5 %).	Completion of construction of all WWTP's units to serve the whole agglomeration area. Construction plans include heating and power plant where natural gas will be utilised.	Completion of construction of all WWTP's units to serve the whole agglomeration area	January 2006

"Lacza" WWTP in Zielona Gora Hot Spot No. 101	Mechanical – biological plant based on 3-stage biological treatment with a capacity of 51,200 m^3/d (195,000 PE). The plant serves 94 % of the population. Sewerage covers 90 % of the city area. Annual average pollution concentration [mg/l] and reduction (%) as of 2001: BOD_5 – 6.2 (99 %) COD – 26 (97 %) N-tot – 14.5 (73 %) P-tot – 0.4 (96 %). The sludge is utilised in municipal composting plant. The sludge quality enables the use for agricultural purposes.	Further development of sewerage (with accompanying equipment such as pump stations) is planned on the remaining part (10 %) of the city area.	Relevant HELCOM Recs. met.	October 2002 *(Deleted)*
Poultry Plant in Prochowice Hot Spot No. 102.1	From June 2001 the Plant produces only canned food (approx. 350 t/year). The plant is equipped with own mechanical-biological plant with sufficient capacity of max. 434 m^3/d. There are two sources of emission to the air: boiler house and cold store (SO_2, NO_2, CO, dust) and permitted limits are not exceeded. The production profile results in small amount of generated wastes (1 thousand tons of wastes generated per year mainly results from the plant's service and maintenance).		Relevant HELCOM Rec. is met.	2002 *(Deleted)*
KGHM "Polish Copper" – Copper Works "Glogow" in Zukowice Hot Spot No. 102.2	Manufacture of electrolytic copper in the form of cathodes and recovering of metallic silver, gold, palladium and platinum slime and technical selenium from a by-product - anode slime. The mill is composed of two units: "Glogow I" and "Glogow II". Ambient emission is automatically measured. The buffer zones have been created. Emission to the air (dust, SO_2, H_2S, CO, Cu, Pb) fulfils required norms. A marginal contamination by Cd, Hg, Cr in discharged wastewater comes from the water drawn for technological purposes. Mainly non-organic waste is generated (slag, dust, lead-bearing slime).	Ecological investment projects for more than EUR 125 million were implemented in 1991 – 2000. As a result the degree of noxiousness of the copper industry in the scope of emission of hazardous substances, effluents and production waste was limited to the level reached by the most modern companies. Closing up the cooling water system resulted in 70 % reduction of wastewater comparing to 1986. All the shaft gases are burnt at local heat and power generating plants. Sulphur is removed from the exhaust gas. Bag filters have been installed. Maximum hermetisation of all processes and the use of the main stream of process gases have been introduced.	BAT is applied.	October 2002 *(Deleted)*

KGHM "Polish Copper" – Copper Works "Legnica" in Legnica Hot Spot No. 102.3	Manufacture of electrolytic copper in the form of cathodes and ingots from continuous casting. Ambient emission is automatically measured. The buffer zones have been created. Emission to the air (dust, SO_2, H_2S, CO, Cu, Pb) fulfils required norms. Own chemical treatment plants. KGHM Polska Miedz S.A. does not discharge cadmium, mercury or chromium in its effluents. A marginal contamination by Cd, Hg, Cr in discharged wastewater comes from the water drawn for technological purposes. Mainly non-organic waste is generated (slag, dust, lead-bearing slime).		BAT is applied.	October 2002 *(Deleted)*
WWTP in Wroclaw Hot Spot No. 103	Mechanical-biological WWTP with chemically supported phosphorus removal. The start-up was completed in July 2001. Sewerage covers 94 % of the city area. The WWTP treats approx. 60 % of the total wastewater volume (70,000 m^3/d). The designed capacity is 120.000 m^3/d. The remaining 40 % undergo treatment on irrigation beds with capacity of 40.000 m^3/d. Annual average pollution concentration [mg/l] as of 2001: BOD_5 – 9.0-10.0 COD – 33.0-41.0 N-tot – 9.0-10.7 P-tot – 1.1-1.2. Sludge is landfilled according to the established rules.		Relevant HELCOM Recs. are met.	2002
"Rokita" Chemical Plant in Brzeg Dolny Hot Spot No. 104	Air emission, including emission from a separate company responsible for energy supply to the plant's units (SO_2, NO_x, propylene, aliphatic hydrocarbons, ethylene oxide, CO_2, dust). Discharge of pollution in wastewater (COD, P, N, heavy metals). The wastewater volume was reduced due to closing down of the phenol, betanaphtol, sorbite, TRI and chloroacetic acid production units. The Plant has introduced automatic wastewater monitoring. In 2001, 17.3 % of wastes generated were utilised or rendered harmless, including 67.4 % of the total generated hazardous wastes.	Modernisation of the Plant's WWTP in progress. In the plant protection product unit the following measures were taken: - installation of modern technology of herbicide conditioning; - removal of chlorophenol historical stockyards; further land reclamation was done as well;	BAT is not elaborated yet for the techniques used in the plant. The requirements of HELCOM Recs. are mostly met, except COD concentration at the outlet. As modernisation of WWTP is almost completed, the parameter will be reached in the nearest future. The Plant has received the "Responsible Care" Certificate and ISO 14001.	2003

"Rokita" Chemical Plant in Brzeg Dolny Hot Spot No. 104 – continued		- reduction wastewater discharge and emission by installation of cyclone (collecting dried herbicides on de-dusting line). With regard to reduction of mercury emission the following measures were undertaken: - modernisation of product cleaning from mercury pollution; - reduction of mercury content in wastewater by installation of a new filter; - modernisation of WWTP.		
"Wizow" Chemical Plant in Boleslawiec Hot Spot No. 106	Production of phosphoric acid and phosphates. Solid wastes resulting from production (phosphogipsum, natrium fluosilicate and post-neutralisation mud) are landfilled or utilised whenever possible, according to accepted standards. The network of piezometers installed in the sludge lagoon and phosphogypsum landfill site area make it possible to closely monitor the impact of waste on groundwater. Technology used enables the reduction of dust and fluorides emission (fluidic and wet scrubbers). Introduction of closed water cycle resulted in 97 % reduction of water intake and wastewater discharged and 99.9 % reduction of phosphorus load discharged in wastewater. Industrial water in closed circulation is treated in the company WWTP.	Continuous reclamation of slopes of phosphogipsum dump.	Relevant HELCOM Recs. met.	October 2002 *(Deleted)*
Agriculture in the Odra river catchment Hot Spot No. 112	The conception of identification of specific areas being the main sources of agricultural run-off is still under elaboration.			

Szczecinski Lagoon Hot Spot No. 113	Transboundary area. The state border divides the lagoon into the Small Lagoon (Germany) and the Great Lagoon (Poland). The Szczecinski Lagoon constitutes part of the Odra estuary and the Odra river basin covers approx. 1/3 of the Polish territory. On the Wolin Island the National Park with the BSPA status was established. The Odra river water is the main source of pollution, however the slow but systematic improvement of its quality is noted. Another significant source of pollution is the city of Szczecin (Hot Spot No. 97). Problems affecting the environment of the Szczecinski Lagoon include: • high eutrophication; • threats to water resources; • storages of specific toxic waste (grave-yards) located near the reservoir; • lack of proper prevention system against flood and droughts; • damage caused by the Russian army formerly stationing in Poland (Swinoujscie). Lack of explicit criteria makes it impossible to determine timeframes/date for deletion from the JCP Hot Spot List.

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

Organisational and Administrative

ATTs	Area Task Teams
BAT	Best Available Techniques
BOS	Environmental Protection Bank
BSPA	Baltic Sea Protected Areas
Dr Eng.	Doctor Engineer
EIB	European Investment Bank
EU	European Union
EUR	Currency unit of the European Union
GFOSiGW	Communal Fund for Environmental Protection and Water Management
GUS	Central Statistical Office
HELCOM	Helsinki Commission
ICZM	Integrated Coastal Zone Management
ISO	International Organisation for Standardisation
ISO 14001	ISO certificate of "Environmental management"
ISO 9002	ISO certificate of "Quality management"
ISPA	Instrument for Structural Policies for Pre-Accession
JCP	Baltic Sea Joint Comprehensive Environmental Action Programme
MPLN	million PLN
MSc.	Master of Science
NFOSiGW	National Fund for Environmental Protection and Water Management
OECD	Organisation for Economic Co-operation and Development
PE	Person Equivalent
PHARE	The EU Programme for Aid for Central and Eastern Europe
PITF	Programme Implementation Task Force
PITF MLW	Working Group on Management Plans for Coastal Lagoons and Wetlands
PLC-3	Third Baltic Sea Pollution Load Compilation
PLC-4	Fourth Baltic Sea Pollution Load Compilation
PLN	Polish currency unit (Polish Zloty)
US	United States
USD	US Dollar
US EPA	US Environment Protection Agency
WWF	World Wide Fund for Nature
WWTP	Wastewater Treatment Plant
WIBOR	Warsaw Interbank Offered Rate
WFOSiGW	Provincial Fund for Environmental Protection and Water Management

Scientific and Technical

Ag	silver
Al	aluminium
As	arsenic
AOX	adsorbable organic halogen
BOD_5	biological oxygen demand
$Ca(OH)_2$	calcium carbonate
Cr	chromium
Cd	cadmium
C_nH_m	hydrocarbons
CN^-	cyanides
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
CS_2	carbon sulfide
Cu	copper
Cu_2S	copper sulfide
DDD	hazardous pesticide (1,1,1-trichloro-2,2-bis(p-methoxyphenyl)ethane)
DDE	hazardous pesticide (1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene)
DDT	hazardous pesticide (1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane)
DMDT	hazardous insecticide Methoxychlor (1,1,1-trichloro-2,2-bis(p-methoxyphenyl)ethane)
d.w.	dry weight
F	fluorine
Fe	iron
Fe_2O_3	ferric trioxide
$FeSO_4$	ferric sulphate
g/GJ	gram per gigajoule
g/h	gram per hour
GJ	gigajoule
GJ/h	gigajoule per hour
g/m^2	gram per square metre
g/t	gram per ton
GWh	gigawatt-hour(s)
ha	hectare
γ-HCH	hazardous pesticide Lindane (gamma-hexachlorocyclohexane)
Hg	mercury
H_2S	hydrogen sulphide
kg/h	kilogram per hectare
kg/d	kilogram per day
KJ/kg	kilojoule per kilogram
km^2	square kilometre
km^3	cubic kilometre
m^3	cubic metre
m^3/d	cubic metre per day
mg/kg	milligram per kilogram

mg/kg d.w.	milligram per kilogram of dry weight
mg/l	milligram per litre
mg/m^3	milligram per cubic metre
mg/t	milligram per ton
Mn	manganese
MPa	megapascal
m^3/s	cubic metre per second
MWe	megawatt electrical capacity
MWt	megawatt thermal capacity
N	nitrogen
n.a.	not analysed
NaCl	sodium chloride
n.d.	not detected
NH_3	ammonia
Ni	nickel
$N\text{-}NH_4$	ammonia nitrogen
NO_x	nitrogen oxide
NO_2	nitrogen dioxide
P	phosphorus
Pb	lead
Pd	palladium
P_2O_5	phosphorus trioxide
Pt	platinum
PVC	polyvinyl chloride
S	sulphur
SO_2	sulphur dioxide
t	ton
th. qu. m	thousand cubic metres
TOC	total organic compounds
-tot	total
VACs	volatile fatty acids
Zn	zinc

BALTIC SEA ENVIRONMENT PROCEEDINGS

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