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PERSISTENT ORGANIC POLLUTANTS

Volume I

National Profile – Poland

WARSAW 2003

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Preface

On May 23rd, 2001, at the Diplomatic Conference in Stockholm, 93 Signatories, including Poland, signed the Convention on Persistent Organic Pollutants, known as the Stockholm Convention. The aim of this treaty is to counteract the adverse effects of persistent organic pollutants on the environment and human health. It introduces prohibition on production and the use or restriction on the use of 12 most toxic, persistent and accumulating in living organisms organic substances as well as requirements to reduce their emissions into the environment. The list of these substances consists of aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, PCBs, DDT, PCDDs and PCDFs.

In August 2001 the Council of the Global Environment Facility (GEF) approved financial assistance to the project "Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs)" aimed at the development of the national Stockholm Convention implementation plans for a number of countries. The United Nations Industrial Development Organization (UNIDO), as the Executing Agency, was appointed to supervise the project implementation.

Thanks to the UNIDO engagement and the effort of national Polish institutions, particularly the Ministry of the Environment (Department of International Co-operation), the Institute of Environmental Protection – especially during the project preparation period, the Ministry of Foreign Affairs (Political Committee for GEF Projects) and the ECOFUND Foundation (National Operational GEF Projects Contact Point), Poland has also become beneficiary of that financial support.

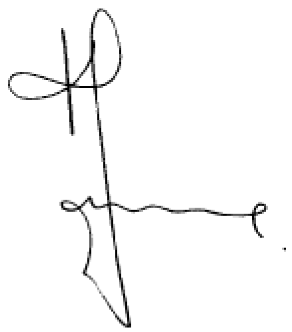
Implementation of the two-year project "Enabling activities to facilitate early action in the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs)" has been entrusted to the Institute of Environmental Protection. The Minister of the Environment appointed the Steering Committee consisting of representatives of the involved governmental departments (environmental protection, health, labour, economy, agriculture, infrastructure, internal affairs and national defence) to co-ordinate and to supervise the merits of the project implementation.

The fundamental task of the interdisciplinary expert team, set up by the Project Manager, was to develop the "National Profile of Persistent Organic Pollutants. Poland", which would present the entire situation – from inventories of production, use, export and import of POPs, through inventories of environmental emissions (into air, water and with wastes), up to the assessment of the Stockholm Convention implementation capabilities, thus, the evaluation of the organisational structures, *legislation, administrative procedures, research activities as well as health and social implications.*

In my conviction, Volume I of the report "National Profile of Persistent Organic Pollutants. Poland", which presents the results of the first year of the project implementation, shall allow the readers, and specifically the decision makers, to understand better problems caused by persistent organic pollutants and realize the scope of work to be done in order to fulfil the provisions of the Stockholm Convention.

The final output of the GF/POL/01/004 project will be the "National Stockholm Convention Implementation Plan" presenting the activities necessary to reduce hazards posed by exposure to POPs.

On behalf of the Minister of the Environment, I wish to express our gratitude to all persons involved in the implementation of this project. I would like to indicate the particular contribution to the preparation of this report by the prematurely passed away Janusz Żurek, an outstanding expert in environmental protection, highly recognized in his homeland and abroad, who was managing the activities of the project expert team.



Krzysztof Szamałek,
Secretary of State in the Ministry of the Environment,
Chairman of the National Steering Committee

EXECUTIVE SUMMARY

This report presents the results of the Inventory Phase of the project "Enabling activities to facilitate early action on the implementation of the Stockholm Convention on persistent organic pollutants (POPs)". The project is financed by GEF, commissioned by UNIDO and executed by the Institute of Environmental Protection. The main objective of the reported phase was to prepare an inventory of hazards caused by the use of hazardous substances subject to the Stockholm Convention in Poland (at present and in the past). The report consists of two parts: an inventory of persistent organic pollutants and the state of preparedness for the implementation of the Stockholm Convention.

The first chapter is devoted to general information about Poland with particular emphasis on environmental management aspects.

In Part I related to inventory activities, an assessment of all the 12 substances controlled by the Stockholm Convention, i.e.: aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex, toxaphene, PCBs, DDT, PCDDs and PCDFs has been carried out.

Analyses of the gathered information indicate that among the substances covered by the Stockholm Convention, only DDT, dieldrin, hexachlorobenzene and toxaphene were used for production of pesticide preparations in Poland. However, in agriculture, apart from the above mentioned substances, also aldrin, endrin and heptachlor preparations were used. Among all these preparations, DDT and toxaphene were produced in Poland while dieldrin, aldrin, endrin, heptachlor and hexachlorobenzene were imported.

Among Polish companies applying electrolysis of rock salt, five enterprises used the so-called, mercury electrolysis using carbon electrodes. In the course of this process PCDDs, PCDFs, HCB and PCBs could have unintentionally been generated as contaminants of products, production equipment and installations.

Preparations subject to the Stockholm Convention are currently neither manufactured or used in our country nor imported or exported. Since the end of the 70s of the 20^{th} century no intentional production of POPs listed in the annexes of the Stockholm Convention has taken place. A minor part of PCB contaminated equipment is exported from Poland for decontamination purposes. Simultaneously, the local capacities for elimination of PCB and PCB polluted equipment are being developed along with restructuring of the Polish chemical industry. Two outdated installations for mercury electrolysis of rock salt have been shut down and chlorination of methane, propylene and acetylene have been eliminated from the production profile. PCBs have been eliminated from production as well as hexachlorobenzene as an intermediate in manufacture of solvents. Far-going modernisation of chlorination processes in all chemical works has been carried out. Processes of safe treatment of waste in facilities applying chlorination processes of organic compounds have been developed. In effect, a considerable reduction of unintentional production of such pollutants as PCDDs, PCDFs, HCB and PCBs has been achieved. Substances and preparations currently used for production of pesticides do not contain POPs.

Outdated plant protection chemicals disposed of in pesticide landfills scattered all over the country constitute the most serious environmental hazard caused by organic pollutants in Poland. In most cases no information is available on the content of these landfills. According to estimates the entire quantity of POPs waste deposited in pesticide landfills is contaminated to such an extent that the situation requires treating them as hazardous waste containing chlorinated organic substances. All these pesticide landfills need to be removed. In liquidation priority should be given to landfills which are situated in unfavourable geological conditions caused by very heavy pollution of the natural ground and the aquatic environment. At some of the pesticide landfill sites the land contamination caused by releases of hazardous substances, including POPs was noted.

Obsolete plant protection chemicals, including those containing POPs, independent from those dumped in pesticide landfills, are still stockpiled in stores of trade companies and individual users. The Regional Directorates of State Forests also store considerable amounts. Identification and quantitative assessment of possible deposits of POPs on landfills of chemical industries is not possible. Sites on which the substances concerned were dumped in the past are unknown, cleaned-up or covered by layers of new wastes, including other hazardous wastes, generated after the production of POPs had stopped. The share of POPs in the whole mass of waste deposited during the years is negligible.

The assessment performed indicates that the removal of possible POP residues remaining on landfills of industrial enterprises, where relevant chemical products were manufactured in the past, is not possible. The fundamental reason for this is the environmental risk connected with the violation of the landfill structure, most of which was reclaimed in the past. Unfortunately, data concerning site contamination of the industrial areas with POPs are not available.

Polychlorinated biphenyls (PCBs) were produced in Poland in small quantities while polychlorinated terphenyls (PCTs) have never been produced. There was, however, a considerable import of these substances as components for insulating oils used in electro-technical equipment. Also electro-technical installations containing such substances were imported. After the regulations of 2002 were issued, requiring PCBs inventory to be made in Poland, the first such inventory has been carried out identifying the actual stocks of equipment and preparations containing this group of substances. However, the greatest problem, both quantitative and technical, is still caused by capacitors, the large number of which is vastly dispersed. Under these circumstances it would be important to consider elimination or decontamination of these appliances randomly without testing them, on the assumption they are polluted, particularly after a decontaminating installation is constructed in Poland.

The PCBs emission into the air in 2000 reached 2320 kg. Electro-energetic installations, particularly capacitors filled with PCB-containing saturants, are the main source of these emissions (71 % of the total PCB national emission). The remaining sources are combustion processes in municipal and household sectors, road transport as well as combustion processes in energy production and transformation.

The annual air emission of HCB is estimated at 8.57 kg. The largest amount up to 50% of that emission is due to combustion processes in the industrial sector, and the major sources within the industry are processes of secondary copper production and sintering of iron ore. Next to the industrial ones, there are the sources connected with waste management and combustion processes in municipal and household sectors. Within these two categories of sources the major part of emission originates from incineration of hospital waste in installations without adequate air protection equipment or fitted with just the simplest emission reduction systems.

The dioxin air emission has been estimated at about 505 g TEQ. Combustion processes in the municipal and dwelling sectors, among others, the use of home stoves, where often household waste is burnt together with fuel, are considered to be the main sources of PCDD/PCDF emissions. The second source of dioxin emission is the waste management sector. The main share in the latter is attributed to emission from industrial waste (including hazardous waste) and incineration processes as well as from destruction of hospital waste in incinerators without combustion gas cleaning systems. Moreover, a significant share in dioxin air emission comes from burning waste on the farmland, fires of waste landfills, buildings and vehicles.

Estimates made during the national inventory of dioxins and furans, performed in accordance with the UNEP Chemicals methodology, revealed that the actual PCDD/PCDF emission volume in this category during the year 2000 could vary between 1–81 g TEQ for hazardous waste and 5.23–123 g TEQ for other industrial waste.

Releases of POPs with wastewater, particularly PCDDs/PCDFs, HCB and PCBs belong to the least recognised elements of environmental hazards caused by these substances. This results from lack of regulatory requirements for the measurements of POPs in wastewater. Under these circumstances the assessment of releases with wastewater has been performed basing on factors published by UNEP. Such estimates were carried out only for PCDDs/PCDFs and amounted to 1217 mg TEQ for the year 2000.

No sufficient data could be collected to enable the assessment of the total PCB and HCB release into waters. It can only be assumed that the share of wastewater treatment processes in that emission should amount to over 50% and the production processes over 15%.

Similar to the case of wastewater, no results of direct measurements of the content of POPs (PCDDs/PCDFs, HCB and PCBs) released into the environment with wastes (except for PCB in electro-technical equipment in use and discarded) are available. The volume of dioxin and furan environmental releases with wastes (341.3 g/year) is comparable with the air emissions of these substances (505.3 g/year).

POPs environmental releases through products occur either in the process of their use or after they turn into waste. Like in the case of wastewater and waste no sufficient and reliable data on the content of these substances in products and the rate of their releases were available. Estimated data indicate that this type of releases is not significant in comparison with air emissions and the releases with waste, being equal to about 10 780 mg TEQ. It can be assumed that more than 50% of PCB and HCB releases originate from secondary paper processing, more than 15% from pesticide production and less than 15% from the remaining processes in pulp and timber industries, PCV production, composting and textile finishing.

Dioxins and furans are released directly into soil as a result of burning dry grasslands, stubble fields and straw as well as bush fires. Preliminary inventory of these releases indicates that this is an insignificant source of dioxin and furan emissions to the environment (4957 mg TEQ) in comparison with the emission into the air and with wastes.

Due to lack of reliable data about indicators of emissions to the soil and about the number of electro-technical installations (transformers, capacitors and energy cables), which are deposited on scrap yards, and municipal waste landfills and which are left on-the-spot after their use is discontinued, the assessment of direct PCB releases into the ground was impossible. Even less information is available in respect of HCB. Possible sources of such pollutant releases into the ground are some of the industrial waste landfills, pesticide landfills and the deposition from air as well as rainwater discharged through leaking sewerages.

During the historical period (1961–1990) the pesticide concentrations in surface waters, not subjected to strong impacts of industrial wastewater discharge and intensive agriculture did not exceed safe levels. However, in waters, heavily polluted (in respect to DDT and DMDT) by industrial wastewater, these concentrations were exceeded. At present, regular measurements of river water pollution by chloroorganic substances are performed at 20 river cross-sections and only in respect to 2 groups of substances controlled by the Stockholm Convention: DDT including its metabolites (DDE and DDD) and PCBs.

The average value of the DDT total in bottom sediments of the Oder River and the water reservoir on the Vistula River in Włocławek exceeded the permitted value for protected areas and was by 50% lower than the permitted content for agricultural and forest land, residential, recreation and wasteland areas and 20 times lower than the acceptable content for industrial and transport areas. The maximum value of the DDT sum did not exceed the permissible value of 250 ng/g of dry matter.

In spite of the fact that chloroorganic pesticides have not been used in Poland for many years, they are still, except for mirex, detected in river waters, bottom sediments and in living organisms. In the bottom sediments of the Włocławek Reservoir, the presence of majority of the PCB congeners, dioxins and furans, identified by WHO as the most toxic, including 2,3,7,8-TCDD dioxins was detected. The level of toxicity of the analysed sediments, determined by the TEQ value, is higher than that at the outlet areas of the Oder and the Vistula Rivers, where some PCB congeners are not detectable in water, but they appear in bottom sediments and fish organs. Moreover, their concentrations in water are lower in comparison with the concentrations in the dry matter of bottom sediments, and the latter – lower than in the fish fat tissue. This clearly indicates the process of accumulation of these substances primarily in aquatic organisms and successively in bottom sediments.

Residues of 8 substances, subject to the Stockholm Convention, present in foodstuffs are characterised by concentrations many times lower than those established on the basis of health criteria as permissible. An assessment of health effects of 4 substances (PCDDs/PCDFs, PCBs, and HCB) generally present in Poland, based on food products has been made. The review of the available data in terms of exposure to these substances and the relevant health risk indicates that information on exposure to dioxins and also to PCB is insufficient, limiting the opportunity of performing a complete health risk assessment.

Scarce data on dioxin and PCB concentrations in human milk demonstrate a high level of exposure of breast-fed babies to these chemical compounds. These data may also indicate that the human exposure in the environment can be the reason for justified anxiety about the potential health hazards. However, the presently possessed data do not constitute a sufficient basis for full assessment of human exposure to chemical substances in Poland.

A review of the Polish legislation concerning environmental protection, chemical substances and wastes revealed that the legal system is generally compliant with the Stockholm Convention and requires only introduction of a few amendments. The current Polish legal system does not contain provisions directly concerning POPs, resulting from the Stockholm Convention implementation plan, for such a plan is expected to be the output of the GF/POL/01/004 Project. However, it should not be expected that in result of the development of such plan significant amendments of the legal regulations would be necessary.

A complete assessment of the efficiency of law regulating POPs issues is currently not possible because most of the relevant regulations have been in force for quite a short period. This is particularly valid for the system of integrated environmental permits but also for regulations concerning chemical substances and preparations. Executive regulations should also be introduced, including for instance the obligation of dioxin measurements in stack gases from processes of incineration and co-incineration of wastes.

The capacity of Polish companies dealing with elimination of outdated plant protection chemicals and liquidation of pesticide waste by incineration has been inventoried and assessed. It is necessary to develop framework guidelines formulating principles for pesticide landfill clean-up activities. Capacities for decontamination of discarded PCB-containing installations are available in Poland, though their use requires introduction of new regulations. Neither facility for thermal destruction of solid hazardous waste containing chloroorganic substances nor opportunities for application of other treatment methods for such waste (i.e. deposition in rock salt excavations) are available. The preliminary review indicates also that no firms present on the Polish market have at their disposal POPs treatment technologies alternative to combustion methods.

The existing system of environmental funds, which may provide financing of activities connected with treatment of POPs, is also described in this Report. Also, the roles and responsibilities of central and voivodship state administration and self-government bodies in the implementation of the Stockholm Convention objectives are discussed. The existing authorities and institutions have sufficient competences to take care of these objectives, though in some instances an extension of the present scope of tasks and responsibilities will be required.

Among institutional factors, which may slow down the implementation of the Convention, shortage of human resources and insufficient qualifications of personnel should be mentioned. The latter refers to the public administration staff (particularly at the *poviat* level), expected to participate in the process of issuing permits required by the Polish environmental protection regulations and the dramatically growing scope of responsibilities of environmental protection services at all management levels (including the central authorities).

On the other hand, among the factors speeding up the implementation of the Convention, the privatisation processes of industry, easier transfer of the best available techniques (BAT) from mother factories in highly developed countries to Poland and the market factors, which in result of competition on the European market will stimulate modernisation processes in Polish enterprises.

The Report stresses the need for broadening and strengthening of the existing state environmental monitoring system by adding measurements, investigations and evaluation of the Stockholm Convention POPs emissions to air, water and soil, conducting dioxin, PCB and HCB emission measurements, pulp bleaching processes, monitoring of the dioxin content in the air in large urban and industrial agglomerations and monitoring of the content of these substances in surface waters and the natural ground. It is also necessary to set the missing standards for the content of dioxins, furans, PCBs and HCB in some food products and also for the emissions from important industrial sources.

Another need is the necessity to establish a system to monitor hazards posed by dioxins, furans, PCBs and HCB to human health including the risk assessment of such threats and trends of their changes in time and space.

The existing capacity of laboratories is sufficient to conduct measurements and analyses concerning POPs. However, their activities are restricted to certain selected compounds and do not comprise the entire set of POPs subject to the Stockholm Convention. Though, the basic problem is lack of appropriate financial support.

It will be also necessary to introduce an extended scheme of statistical investigations allowing for a better insight into economic information concerning the scope of the activities covered by the Convention, specifically data on activities and conditions of waste incineration, particularly hazardous waste as well as construction of an information system concerning the dioxins, furans, PCBs and HCB in products.

Because of very low awareness of the Polish public about the harmful influence of dioxins and PCBs and about the related problems of uncontrolled burning of waste at households, an extensive public educational programme on proper waste handling and on hazards connected with their burning should be initiated.

INTRODUCTION

The GF/POL/01/004 Project "Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs)" is executed under the Contract No. 2001/369 concluded between the United Nations Industrial Development Organization (UNIDO) and the Institute of Environmental Protection (IEP). The Global Environment Facility (GEF) provides financial resources. The main objective of the Project is to make an inventory of threats connected with the use (at present and in the past) of hazardous substances covered by the Stockholm Convention and the development of the National Implementation Plan.

Inventory and programming activities have been going on in Poland for some time in connection with the implementation of the "National Environmental Policy" of 1991, the implementation of the Aarhus Protocol obligations and the approximation of Polish law with the legislation of the European Union.

This report presents the results of the Inventory Phase of the GF/POL/01/004 Project, lasting 7 months (March – December 2002), which, according to the two-year project implementation plan should be concluded by the development of the "National Profile of Persistent Organic Pollutants. Poland". The report was prepared by experts on the basis of the results of measurements performed within the framework of the project, the results of research and inventory activities carried out to date, available data from measurements and statistics, existing evaluations and information, discussions and recommendations developed during the GF/POL/01/004 Project Inception Seminar (Warsaw, 21–22 March 2002) and during the workshop of the Inventory Phase (Warsaw, 2 December 2002) as well as on national expert reports (Annex 5.B) and international reports (Annex 5.C). Detailed information is provided by the Technical Reports (Annex 5.A) developed in the course of project implementation during the Inventory Phase, accessible on Internet Websites under http://ks.ios.edu.pl.

The structure of this report has been adopted with due regard to the IOMC guidelines ("Preparing a National Profile to Assess the National Infrastructure for Management of Chemicals. A Guidance Document") and the specific situation in Poland, both in relation to the production structure, the use and the emission of POPs and the structure of legal regulations, management and supervision system and the economic capacity.

The situation in Poland, concerning all the 12 substances covered by the Stockholm Convention, has been assessed. The following substances or groups of substances were taken into consideration:

- Aldrin (CAS No: 309-00-2)
- Chlordane (CAS No: 57-74-9)
- Dieldrin (CAS No: 60-57-1)
- Endrin (CAS No: 72-20-8)
- Heptachlor (CAS No: 76-44-8)
- Hexachlorobenzene, HCB (CAS No: 118-74-1)
- Mirex (CAS No: 2585-85-5)
- Toxaphene (CAS No: 8001-35-2)
- Polychlorinated biphenyls, PCBs
- 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane, DDT (CAS: 50-29-3)
- Polychlorinated dibenzo-p-dioxins, PCDDs
- Polychlorinated dibenzofurans, PCDFs.

PART I

INVENTORY OF PERSISTENT ORGANIC POLLUTANTS IN POLAND

1. BASIC INFORMATION ABOUT POLAND

1.1. CONSTITUTIONAL STRUCTURE, OFFICIAL LANGUAGE AND ADMINISTRATIVE DIVISION

The Republic of Poland is a constitutional republic of a mixed, presidential and parliamentary model of authority. The legislative authority belongs to the *Sejm* (lower Chamber of the Parliament) and the Senate. Joint debate of the *Sejm* and the *Senate* is called the National Assembly. The President and the Council of Ministers hold the highest executive power. The Government – the Council of Ministers, headed by the President of the Council of Ministers – is responsible for the domestic and foreign state policy. At the regional level the government administration is represented by the voivodes (governors) and at district level by the *starosts* (district heads), within the framework of entrusted tasks. Polish is the official language.

On 1st January 1999 a new, three-level territorial division, was introduced. It consists of 16 voivodeships (regions), 315 *poviats* (districts) plus 65 cities with district rights. The basic 2489 administrative units – *gminas* (municipalities) – remained unchanged. They are subdivided into 40057 auxiliary village administrations.

1.2. GEOGRAPHIC, DEMOGRAPHIC AND ECONOMIC DATA

A. Geographic environment of Poland

Poland is situated within the temperate geographical latitudes (49°00’–54°50’) of Central Europe, south from the Baltic Sea. The country’s area, including maritime internal waters of the Vistula Bay and Szczecin Bay, is 312 685 km^2. The surface of Poland is, in terms of latitude, formed from coastal lowlands in the North, through hills of the lake districts, vast central lowlands and mountains located in the South from which the two largest rivers: Vistula (1047 km) and Oder (854 km) originate. 54% of the territory lies below 150 m above sea level, close to 37% at the level 150–300 metres above sea level. Highlands and mountains (over 300 m above sea level) cover almost 8% of the country's territory, out of which the mountains represent only 0.1% of the Polish territory.

Such a shape of the terrain, with growing altitude from the coast of the Baltic Sea southwards, presents a significant factor of the formation of climate conditions in Poland, allowing free exchange of air masses. This is demonstrated by considerable variety of climate conditions from year to year and the weather changes from day to day. The average annual air temperature in Poland has a growing tendency (from 7.4°C during 1951–1980 to 8.0°C during 1991–1999). The effect of the shape of the Polish terrain is most visible in the distribution of precipitation totals. The average precipitation total is 600 mm, with the lowest rainfall in Central Poland (approx. 500 mm) and the highest in the mountains (about 1500 mm), higher in summer than in winter. Variation in the intensity and spatial distribution of annual precipitation is high.

In terms of water supply Poland belongs to the poorest countries in Europe, having 1800 m^3 annual water run-off per inhabitant, i.e. three times lower value than the European average and four times lower than the global average. Large seasonal and territorial differentiation of water resources may cause seasonal water shortage or excess of water in many country regions. The capacity of retention reservoirs in Poland is rather small. Being able to retain just 6% of the total annual water run-off, they do not ensure protection against drought or flood.

During recent years the water intake for household and industrial purposes has declined markedly. The average intake during 1995–1999 was by as much as 21% lower than in 1988, resulting mainly from reduced water consumption by the industry

Table 1.1. Total area of Poland according to types of land use

Type of land use	Land area in specific years					
	1988		1990		2000	
	[1000 ha]	[%]	[1000 ha]	[%]	[1000 ha]	[%]
Farmland	18 835	60.2	18 784	60.1	18 537	59.3
Forests and woods	8 864	28.4	8 884	28.4	9 094	29.1
Waters	823	2.6	826	2.6	833	2.7
Mines	42	0.1	42	0.1	38	0.1
Transport areas	986	3.2	989	3.2	959	3.1
Residential areas	932	3.0	952	3.1	1 050	3.4
Waste land	500	1.6	504	1.6	499	1.6
Other	286	0.9	288	0.9	259	0.7

(responsible for 70% of the total water consumption), but also from water saving by households and agriculture. Over 83% of the water used originates from surface water resources, 15% from underground water and 2% from mining activities.

Farming and forestry are the dominating forms of land use in Poland, covering almost 89% of the country's territory. Most of the farmland area, close to 88%, is arable land and the remaining 12% is grassland. The area of farmland is systematically declining, primarily to the advantage of forestry, residential areas, idle land and communication trails.

B. Social situation

Population. Since mid eighties the rate of population growth in Poland has been decreasing. During 1989–1999 the population of Poland increased by 782 thousand, reaching 38667 thousand at the end of 1998, but the trend of decreasing birth rate, observed earlier, went dramatically further down from 4.8‰ to 0.5‰. In 1999, for the first time since the World War 2, a negative population growth was recorded, due to the fact that the birth rate attained 0.0‰ (600 persons), and the balance of emigration was minus 14000. In the following years the population number was decreasing reaching at the end of 2000 a total of 38644 thousand.

The population age structure is changing unfavourably. Declining number of births causes a drastic reduction in the share of population of pre-working age in the total population (from 29.8% in 1989 to 24.1% in 2000), with parallel growth of the production and post-production age population shares (from 57.6% in 1989 to 61.2 in 2000, and from 12.6 in 1989 to 14.7 in 2000, respectively). The share of urban population stabilized during the nineties at 61.8%. There were 880 towns and cities in 2000, among which 19 cities had more than 200 thousand dwellers. The population of Warsaw, the capital and the largest Polish city, was 1.6 million inhabitants.

The average population density is 124 people per 1 km^2, though in the most densely populated Silesian Voivodeship 396 people live on 1 km^2. The north-eastern regions – Podlaskie and Warmińsko-Mazurskie, with 61 people/km^2 are the least populated in Poland.

Unemployment. Significant changes on the employment market took place during the transformation of the Polish economy (1990–2000). Three specific periods of these changes can be distinguished:

- The period of economic changes during 1990–1993 was marked by significant decrease in demand for labour by as much as 2628 thousand people and an increase in the number of unemployed; this trend was slowed down only in 1994;
- The years 1994–1997 was a period of fast economic development with 6.8% annual GDP growth; the situation on the employment market was gradually improving as a result of good economic opportunities, slow down in restructuring

Table 1.2. Number of the registered unemployed persons and the unemployment rate

Years	1990	1995	1996	1997	1998	1999	2000
Unemployed [thousands]	1126.1	2628.8	2359.5	1826.4	1831.4	2349.8	2702.6
Rate of unemployment [%]	6.5	14.9	13.2	10.3	10.4	13.1	15.0

of economy and decrease of illegal employment; the number of employed grew by 1180 thousand and the unemployment rate decreased to 10.3%;

- Since 1998 the number of unemployed has been growing, the rate of unemployment went up to 18% in 2002, as a result of slow down in economic growth and acceleration of reconstruction processes of some industrial branches, as well as a significant reduction in production volume, trade and service activities, caused by unfavourable situation on world markets; in addition an increased flow of graduates, in connection with the demographic tide entering the labour market, made the situation even worse.

C. Economic situation

The process of deep social and economic transformation started in 1989 aimed at the change of fundamental ownership relationships, implementation of active anti-monopoly policies, liberation of prices and attaining price structures compatible with the prices on world markets, opening the economy, setting up the capital market and opening the country to foreign investment capital. During the first two years of transformation (1990–1991) a transitory breakdown of the Polish economy took place. A break-through of this recession came in 1992, when an improvement of market condition began leading to gradual strengthening of reconstruction processes. The highest development rate was achieved by the Polish economy in 1995 and retained at this level for the next two years. It still remains positive, though the pace of growth has fallen since 1997.

Gross National Product. Since 1994 the pace of the GNP growth was high, reaching the 7% top level in 1995. The following years were also favourable with 6% and 6.8% increase in 1996 and 1997, respectively, mainly as a result of an increase in both, domestic consumption and investment market demands. Economic development was stimulated additionally during that period by an increase of the employment rate linked to improved labour efficiency, significant slow down of inflation growth and revival of international trade under progressing turnover liberation conditions. After 1997 the annual GNP went gradually down from 4.8% in 1998 to 4.1% in 2000 as a result of reduced demand on the internal and global markets.

Table 1.3. Generation structure of GNP during 1995–2000

Gross added value	GNP structure in current prices in years [%]				
	1995	1997	1998	1999	2000
Total	87.1	87.4	87.6	87.2	87.8
Agriculture, hunting and forestry	6.0	4.8	4.1	3.4	3.3
Industry total, including:	27.6	25.7	24.2	23.6	23.4
• Underground and placer mining	3.6	3.1	2.5	2.3	2.4
• Manufacturing	20.6	19.6	18,9	18.3	18.1
• Supply of energy, gas and water	3.4	3.0	2.8	3.0	2.9
Building industry	6.3	6.9	7.6	7.6	7.3
Services total, including:	47.2	50.0	51.7	52.6	53.8
• Trade and repair	17.4	18.4	18.1	18.2	18.3

Source: GUS – Central Statistical Office.

Agriculture. The majority of Polish farming retained traditional patterns, characterised by diversified and extensive production. Over 40% of individual farms are running mixed production without any specific specialization, crop production prevails in 33% of farms and animal production and breeding is the main branch in 20% of farms. The share of agriculture, hunting and forestry in the GNP generation amounts to 3.3% in the year 2000. The structure of agricultural commodity production in 2000 by specific products (data from GUS – Central Statistical Office) is as follows:

1. Crop production total of 39%, including:
   - cereals 11.7%,
   - cash crops 7.4%,
   - potatoes 3.0%,
   - vegetables 7.7%,
   - fruits 7.8%.
2. Animal production total of 61%, including:
   - beef cattle 5.1%,
   - porker pigs 23.5%,
   - milk 17.8%,
   - eggs 4.4%.

Table 1.4. Individual farms according to acreage categories

Specification	Years			
	1990	1995	1998	2000
Farms in thousands	2138	2048	1989	1881
Percentage of farms having an acreage of [ha]:				
• 1.01 – 1.99	17.7	20.9	22.6	23.8
• 2.00 – 4.99	35.1	33.7	34.0	32.6
• 5.00 – 6.99	14.9	13.4	12.4	11.4
• 7.00 – 9.99	14.9	13.3	12.3	12.4
• 10.00–14.99	11.3	10.7	10.2	9.9
• 15.00 and more	6.1	8.0	8.5	9.9
Average total farm acreage [ha]:	7.1	7.6	8.5	8.0
of which arable land [ha]:	6.3	6.7	6.9	7.2

Source: GUS – Central Statistical Office.

Vast majority of Polish farms are small in size. The average acreage of agricultural land in family farms was 7.2 ha in 2000, though the majority belonged to the 1–5 ha category, while the share of large farms, over 50 ha, was only 0.7%. During the last decade a significant change in the ownership structure of arable land has occurred in favour of the already dominating individual farms, which had 83.9% of the farmland at disposal in the year 2000.

The individual farms manufacture 86% of the total commodity production. Within the latter, animal production is prevailing with pig, cattle and poultry production. The basic crops are cereals, potatoes and cash crops, which constituted 86.6% of the total sowing area in 2000.

Application of mineral fertilisers has been drastically reduced. During the period of the greatest reduction (1991/1992) the mineral compounds used in fertilisers constituted only 32% of the rate of 1988/1989, of which 41% were nitrogen fertilisers. In the year 2000, the fertilisation intensity was still as much as two times lower than in 1988.

Application of plant protection chemicals (pesticides) was of a similar character. This was linked mainly to the dissolution of large-scale state farms, which used the largest share of herbicides and pesticides. Their use was stabilised by the end of the nineties somewhat below 9000 tonnes of active substances in the whole agriculture, and about 60 kg of active substances per 100 ha of arable land. Herbicides constitute the majority among the used plant protection chemicals. Pesticides, fungicides

Table 1.5. Supply of active pesticides for agricultural application

Active pesticide substances	Years						
	1990	1995	1996	1997	1998	1999	2000
Total [tonnes]	7548	6962	9420	9501	8699	8469	8848
Per 100 ha of arable land [kg]	51.5	47.8	66.3	66.3	60.5	58.8	61.7

Source: GUS – Central Statistical Office.

and seed treatment preparations represent some 50% of the used herbicides. Pesticides containing active substances covered by the Stockholm Convention are not used in Poland.

Industry. The basic source of economic growth remains the industry, despite the 23.4% reduction of its share in the GNP generation. After a considerable fall in 1990 the industrial sold production was growing, attaining the highest level in 1994 exceeding by 12.2% the previous year's ceiling. In 1995–1999 the average annual growth of industrial sold production was 7.6%.

The private sector, with 70% of the total production sold, begins to play an important role, though in 1995 its contribution was just about 47%. The number of private industrial enterprises, particularly small and medium sized, has been growing very fast. In accordance with the adopted strategy, the privatisation process concerning basic branches of economic infrastructure, such as energy, gas and mining industry, will continue.

Transition towards market economy forced transformations and changes in the Polish industry. The share of underground and placer mining declined to the benefit of the processing industry. In a number of industrial sectors far-going restructuring took place resulting in a shut down of a number of facilities and different types of production. This affected specifically: ferrous metallurgy, coke making, coal mining and the chemical industry.

Table 1.6. Structure of industrial enterprises in terms of number of employees (as of 31.12.1999)

Particulars	Enterprises			
	micro	small	average	large
Number of enterprises	198 629	36 650	6276	1791
Number of employees	1 – 9	10 – 49	50 – 249	above 250

Source: GUS – Central Statistical Office.

Table 1.7. Industrial sold production according to branches and ownership sectors

Branches	Years	Total [billion PLN]	Sector	
			Public [billion PLN]	Private [billion PLN]
Grand total	1995	244.5	129.6	114.9
	1997	359.0	128.3	230.7
	1998	390.0	120.0	270.0
	1999	427.0	127.5	299.5
	2000	503.0	140.5	362.5
Underground and placer mining	1995	19.5	19.0	0.5
	1997	26.0	24.5	1.5
	1998	24.0	22.0	2.0
	1999	25.0	22.5	2.5
	2000	27.0	19.5	7.5
Processing industry	1995	200.6	86.6	114.0
	1997	300.0	71.8	228.2
	1998	330.0	64.0	266.0
	1999	359.0	64.0	295.0
	2000	427.0	75.0	352.5
Production and supply of electric energy, gas and water	1995	24.74	24.0	0.4
	1997	33.0	32.0	1.0
	1998	36.0	34.0	2.0
	1999	43.0	41.0	2.0
	2000	49.0	46.0	3.0

Source: GUS – Central Statistical Office.

The total value of the sold production in 2000 was 503 billion PLN in current prices. This amount includes the underground and placer mining (27 billion PLN), processing industry (427 billion PLN) as well as production and supply of electric energy, gas and water (49 billion PLN). The highest concentration of industry is found in the Mazowieckie, Śląskie, Wielkopolskie, Dolnośląskie, Małopolskie and Łódzkie Voivodeships.

In terms of production and employment value in industrial enterprises the dominating industries are: food industry, machines and installations, metal products, products of non-metallic raw materials, chemical products (including the rubber and plastics industry and power generation and supply).

Table 1.8. Main industrial branches, employment and production value (includes enterprises with over 50 staff members)

Type of production	Number of enterprises	Average employee numbers [thousands]	Production value [billion PLN]
Food products	1748	320.2	66.8
Textile industry	368	79.1	6.7
Timber and timber products	422	73.9	10.1
Paper pulp and paper	165	29.0	8.5
Chemical products	297	100.1	25.6
Rubber and plastic products	506	72.0	12.5
Products of non-metallic raw materials	516	111.4	16.3
Metals	181	93.4	22.4
Metallic products	738	114.3	13.9
Machines and installations	846	180.8	17.2
Motor vehicles	242	87.2	29.9
Underground and placer mining	165	234.6	26.2
Production and supply of energy, gas, steam and hot water	576	222.9	43.5
Total	**9430**	**2 271.9**	**395.9**

Source: GUS Statistical Yearbook. Industry 2001.

1.3. CENTRAL AND REGIONAL ENVIRONMENTAL AUTHORITIES

Environmental protection constitutes one of the constitutional tasks of the state as well as the right and responsibility of the citizens. The fundamental law (Constitution of the Republic of Poland dated 1997) states: "*The Republic of Poland (...) shall ensure the protection of the natural environment pursuant to the principles of sustainable development*" and "*Public authorities shall pursue policies ensuring the ecological security of current and future generations*".

The chief state administration authority supervising and co-ordinating environmental protection activities is the Minister of the Environment, who fulfils his functions using the executing body – the Ministry of the Environment. Basic tasks and competences of the Minister of the Environment include development of proposals for state policies (and strategies) concerning environmental protection, initiation of legislation and implementation of the adopted policies and enacted laws.

The National Environmental Policy adopted in 1991 and updated periodically together with adequate Action Plans are fundamental for the Polish environmental protection policy. The National Environmental Policy defines in particular the objectives of environmental protection, its priorities, types and time schedules for the implementation of activities planned and the resources necessary to achieve the established goals. At present, the second National Environmental Policy is being implemented. Simultaneously, activities are under way to obtain the Parliament's approval of the new policy for the period 2003–2006 adopted by the Council of Ministers in December 2002.

Environmental management is based on an extensive and systematically updated system of laws. The following acts are the most important new or amended laws: Environmental Protection Law, Spatial Planning Law, Law on Environmental Protection Inspection, Forestry Law, Nature Protection Law, Agriculture and Forest Land Protection Law, Law on Maintaining Order and Cleanliness in Gminas, Law on Fertilisers and Fertilisation, Geological and Mining Law, Water Law, Waste Law, Law on Packaging and Packaging Waste, Law on Chemical Substances and Preparations and the Cultivated Plants Protection Law. All these laws take into practical consideration the legislations of the European Union, in connection with the future EU membership of Poland.

The existing legal regulations include penal responsibility for violation of law and infringement against the environment. One of the significant sanctions for striking abuse of environmental protection principles is the possibility of shutting down production activities of an economic entity violating these principles.

Financial resources such as monetary charges and fines for the use of the environment and its pollution are collected into the environmental funds at different levels: *gmina, poviat,* Voivodeship and the National Fund for Environmental Protection and Water Management. These resources are among the major means for financing environmental development projects of national or regional priority.

Ministers responsible for specific sectors are also responsible for ensuring conditions necessary to implement environmental protection regulations (see Chapter 8).

At all levels of state administrative division (see item 1.1) there are general responsibilities for environmental protection as well as a certain degree of budgetary freedom (supported additionally at each level by the resources of environmental protection and water management funds).

The voivode is the regional state administration authority responsible for environmental protection. He executes his duties through the divisions of environmental protection. The basic tasks and competences of the Voivodeship environmental protection divisions are:

- Issuing administrative decisions permitting the use of environmental resources and determining terms of such use in respect of activities which potentially may exert significant environmental impacts (as well as installations running within the site of facilities regarded as such activities);
- Prescribing additional requirements on specific areas and establishing areas of restricted use for activities which potentially may exert significant environmental impacts;
- Maintaining databases, among others on: types, quantities and sites of presence of substances representing a particular environmental threat (based on information from entities, chiefs of *gminas*, mayors and city presidents) and on type and scale of use of the environment;
- Performing control activities;
- Preventing environmental threats in extraordinary situation.

Voivodes are in charge of the comprehensive governmental administration bodies (particularly police and fire brigades as well as environmental protection inspection, sanitary inspection and others). The voivode has considerable management, regulation and control competences, but has no freedom in creating policies, since, as a representative of the government, he has the task to secure the national interest versus local self-governments.

At the territorial level, within the Voivodeship, *poviat* or other organisational and spatial systems, bodies of non-comprehensive governmental administration are functioning (among others customs offices, statistical offices, state forest administration, maritime offices, water management authorities).

The Polish self-government authorities are:

- *Gmina* councils, *poviat* councils, voivodeship *sejmik* (diet) – as local legislative authorities,
- Chief (*wójt*), mayor (*burmistrz*) or president of *gmina*, *poviat* managing board and district head (*starosta*), voivodeship managing board and the voivodeship marshal (*marszałek województwa*) – as executive authorities.

According to the Environmental Protection Law the Voivodeship marshal, *starosta* and *wójt,* mayor or president of a city are in charge, in accordance to their responsibilities, of compliance and enforcement of environmental protection regulations.

The Voivodeship self-government authorities determine the strategy of Voivodeship development, decide on the Voivodeship sustainable development and environmental protection programme and the programmes for implementation of extra-local public goals as well as governmental tasks included in the register of the voivode. Practically they have no management, regulating nor controlling power what-so-ever, but have considerable influence on the Voivodeship Fund for Environmental Protection and Water Management, being in charge of resources required for the implementation of environmental protection projects.

At the *poviat* level the *starosta* is the environmental protection authority responsible, among others, for:

- Issuing decisions granting integrated permits, permits to release gases or dust into the air, permits to discharge wastewater into water or ground and permits to generate solid waste, including hazardous waste;
- Issuing decisions obliging to: prepare an environmental impact assessment report for the proposed project, which may exert a significant impact on the environment, prepare and submit the environmental audit report on installations, restrict the negative environmental impact or its threats, restore the state of the environment to its proper shape, perform periodical measurements of emission and present the results obtained and issue requirements for land reclamation procedure;
- Maintaining a register concerning information: on areas where the soil quality standards have been violated, with particular attention to such areas which are supposed to be cleaned up by the *starosta* and about the generated solid waste and methods of their management;
- Implementation of the *poviat* environmental protection programme.

The basic competences of *gminas* are primarily concerned with issuing permits to implement capital development projects (decisions on building and site arrangement conditions) as well as nature conservation and solid waste management.

Gminas have considerable freedom in shaping their ecological type of development through adequate entries in the local plan of spatial management. The only remaining limits to that freedom are: (1) the necessity of securing financial resources and (2) the need to ensure, that such ideas are included in the governmental action plan negotiated with the voivode and the action plan of the Voivodeship self-government negotiated with the marshal, as activities supporting extra-local public objectives.

The fundamental responsibility and decisions concerning specific activities aimed at environmental protection are assigned to the economic entities and local self-governments, having the ultimate say and disposing of financial resources both from their own sources and obtained from environmental funds.

2. PRODUCTION, EXPORT, IMPORT AND USE OF PERSISTENT ORGANIC POLLUTANTS

2.1. PAST PRODUCTION, EXPORT, IMPORT AND USE OF POPs

2.1.1. Introductory information

Substances covered by the provisions of the Stockholm Convention are subdivided into two main groups as follows:

- Substances produced intentionally by the industry; this group includes: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), toxaphene, mirex and polychlorinated biphenyls (PCBs);
- Substances generated unintentionally, which include polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs) and hexachlorobenzene (HCB).

Hexachlorobenzene is present in both of the above mentioned groups as a pesticide, as a chemical intermediate and as a substance found in products of combustion processes, accompanying PCDDs, PCDFs and PCBs released during such processes.

Polychlorinated biphenyls appear in two different types: as mixtures intentionally produced by the industry and used for insulating purposes in electro-technical appliances and as pollutants, in products of combustion processes and accompanying PCDDs, PCDFs and HCB present in such products.

It must be added that PCDDs, PCDFs and PCBs may, in varying proportions, be present in chlorination products manufactured intentionally. They may also appear in the pesticides mentioned above, including hexachlorobenzene, and, apart from pesticides, also in PCBs.

Two basic terms are used in this report in relation to pesticides and also polychlorinated biphenyls in respect of forms of their appearance in the process production and market turnover – the term "substance" and the term "preparation" (definitions – see Annex 1).

POPs found in Poland originated from four basic sources:

- From domestic production of chemical substances,
- From importation of substances not produced within the country,
- From domestic production of preparations (final forms) of pesticides,
- From importation of preparations (final forms) of plant protection chemicals (pesticides).

Substances, subject to the Stockholm Convention, were produced in Poland by five enterprises. Pesticides were manufactured by the Chemical Works AZOT in Jaworzno, Organic Industries ROKITA in Brzeg Dolny and the Chemical Works GAMRAT in Jasło (small amounts of DDT-containing preparation). The Nitrogen Works in Tarnów-Mościce and the ERG Works in Ząbkowice Będzińskie produced polychlorinated biphenyls. Hexachlorobenzene, as an intermediate, occurred in the ANWIL in Włocławek and as a waste product or a product contaminant in the Chemical Works ORGANIKA in Sarzyna, Organic Industries ROKITA in Brzeg Dolny and in the Nitrogen Works in Tarnów-Mościce.

2.1.2. Domestic production and export of active pesticides

DDT (1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane. The basic active substance, produced in Poland for many years, classified as a pesticide, was DDT, distributed under the name of *Azotoks.*

Since 1972 the entry *Azotoks* in the Statistical Yearbook, has been presented as "DDT and analogues". In this case the DMDT (1,1,1-trichloro-2,2-bis(methoxyphenyl)ethane) was regarded as an analogue of DDT (1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane) marketed under the name of *Metoksychlor*. The definition of DMDT, as an analogue of DDT, apparently originated from the fact that production processes of both compounds are very similar. The difference is that one of the basic raw materials for DDT production was the monochlorobenzene, which in case of DMDT was replaced by the metoxybenzene (brand name *Anizol*). In this connection, attention should be drawn to the fact, that DMDT is not among the substances included in the Stockholm Convention. Introduction of DMDT production in Poland enabled the reduction of the content of DDT in plant protection preparations applied in agriculture, forestry and households.

Table 2.1 illustrates the volume of *Azotoks* concentrate production, and since 1972 the production of DDT and analogues (calculated as 100%).

Statistical yearbooks and bulletins of the chemical industry do not provide data concerning the volume of exported DDT concentrate nor pesticide production based on DDT. It is merely known that the volume of export was considerable and directed to the Asian countries. The size of export may be quite accurately defined for the years 1976 and 1977, because the permitted use of preparations containing DDT ceased in 1975. If so, then the entire amount of DDT would have been exported in the form of concentrated or ready-to-use pesticides. Hence, it would been 678 tonnes in 1976 and 2270 tonnes in 1977 (calculated as pure substance).

Another method of determining the volume of DDT concentrate export is to acknowledge the volume of export as the difference between the DDT production and

Table 2.1. Production of DDT in Poland during 1949–1977

Year	Production [tonnes]	Year	Production [tonnes]
1949	35.0	1964	3845.0
1950	146.6	1965	4407.0
1951	221.0	1966	4378.0
1952	343.0	1967	4479.0
1953	803.0	1968	3729.0
1954	1118.0	1969	3487.0
1955	1493.0	1970	3805.0
1956	1648.0	1971	3485.0
1957	2108.7	1972*	(3377.0) 3977.0
1958	2470.7	1973*	(2318.0) 2918.0
1960	3142.0	1974*	(2855.0) 3455.0
1961	3754.7	1975*	(2755.0) 3355.0
1962	3686.0	1976*	(1678.0) 3278.0
1963	3322.0	1977*	(2270.0) 2870.0

* For 1972–1978 the volume of DDT production (in brackets) was reduced by the volume of *Metoksychlor* production.

its use for production of preparations, assuming that only the concentrate was exported. This difference for the years of maximum DDT production varies from 1000 to 1500 tonnes/year. However, these data may be charged by a considerable error, for the Statistical Yearbooks of the Chemical Industry and the Statistical Bulletins of the Ministry of Chemical Industry do not provide information on the methodology applied for preparation and processing of statistical data concerning the production and use of pesticides.

Therefore, we may only be sure of the total volume of DDT concentrate production. It amounted to 75759.7 tonnes of DDT concentrate calculated as 100% substance during the period 1949–1978.

Toxaphene. Toxaphene is a mixture of compounds produced in the process of chlorination of terpene and camphene. In both cases toxaphene represents a mixture of substances containing various concentrations of chlorine, and with reference to chlorination of terpene, also a mixture of chlorine derivatives of different terpenes.

According to the Statistical Yearbooks of the Chemical Industry the chlorinated terpenes were produced under the name *Terpentol* in 1961 and 1962. This production can be regarded as experimental manufacturing, since the output in 1961 was 25 tonnes and only 15 tonnes in 1962. The product of terpene chlorination was subsequently processed into a preparation called *Liquid Terpentol.* It contained 60% of chlorinated terpenes. Forty tonnes of chlorinated terpenes (toxaphene) were produced in total.

The Chemical Works in Jaworzno used to produce a preparation based on toxaphene, but representing the chlorinated camphene. The Statistical Yearbook of the Chemical Industry, however, does not mention the fact that chlorinated camphene was produced. This may suggest that it was produced with the use of imported toxaphene or an error occurred in course of registration while in reality *Terpentol* originating from the ROKITA works was processed into the ready-to-use form.

Polychlorinated biphenyls (PCBs). Polychlorinated biphenyls were produced by two industrial enterprises:

- During 1971–1976 by Nitrogen Works in Tarnów-Mościce under the commercial name of *Tarnol* or *Chlorowany Bifenyl* as a mixture containing 40% of chlorine in a single molecule. The properties of *Tarnol* were close to such products of foreign companies as: Aroclor 1248, Clophen A40, Phenoclor DP-4, Fenchlor 42 and Kanechlor 400. The total production of *Tarnol* amounted to 679 tonnes. The major part of the *Tarnol* composition represented trichlorobiphenyls, though this product contained also bi-, tetra-, and pentachlorobiphenyls;
- The ERG Works in Ząbkowice Będzińskie under the commercial name *Chlorofen*. Main compounds of *Chlorofen* were the derivatives of biphenyl, containing from five to nine atoms of carbon per PCB molecule. It was used in coal mining, presumably as a fireproof hydraulic fluid. However, no information is available about the volume of PCB production by the ERG Works.

Aldrin, dieldrin and hexachlorobenzene (HCB). The Polish chemical industry enterprises conducted experiments aimed at possible introduction of industrial manufacturing of aldrin, dieldrin and hexachlorobenzene, though the actual production of these substances has never been launched. HCB emerged, however, in the chemical industry as an intermediate product during the process of manufacturing vinyl chloride and solvents in a hermetic system on a restricted area, and as such was not subject to inventory. Moreover, HCB was found as an unintentional pollutant in production processes of the following substances: chlorobenzene, pentachlorophenol, MCPA, 2,4-D, chloroorganic solvents, experimental production of 2,4,5-T and also in copper production processes.

2.1.3. Domestic production and import of pesticide preparations

POPs were marketed under the form of chemical preparations composed of chemical substances covered now by the Stockholm Convention.

Issues concerning the admission of pesticides for marketing and use in Poland were legally regulated by the “Law on Plant Protection Against Diseases, Pests and Weeds” published for the first time in the Dziennik Ustaw No. 10, item 55, of 1961 (*Official Journal of Laws of the Republic of Poland*, see: Annex 1). At that time, this act was not prohibiting production and use of chloroorganic compounds, presently included in the POPs group. Thanks to that act and the publication of annual announcements on lists of chemicals of plant protection admitted to commercial turnover for the given year by the Official Gazette of the Ministry of Agriculture, the establishment of the type of chemical plant protection substances imported as well as of the type of biologically active substances they contained, was possible.

Domestic production of pesticide compounds. As mentioned above, the production of pesticides covered by the Stockholm Convention continued in Poland from 1948 until 1978. The list of commercial names of preparations produced is presented in Table 2.2.

Table 2.2. reflects the content of POPs in specific preparations with sufficient accuracy. Unfortunately, apart from preparations containing DDT and “Terpentol”, no other data on the volume of these preparations released into the environment are available.

The structure of production of pesticides, containing DDT was quite well developed in Poland. The Statistical Yearbooks published it until 1970. Since 1971 the Statistical Bulletins of the Ministry of Chemical Industry informed about the pesticides jointly, without indicating the purpose of their use. Table 2.3. illustrates, as an example, the structure of DDT-containing pesticides produced during the years 1965–1970.

No sufficient information is available on the use of chloroorganic pesticides. It is known that 3257 tonnes of DDT were used in Poland in 1961 and 1081 tonnes in 1964. These values are comprised within the amounts of DDT produced at that time domestically: 3754.7 tonnes and 3845.0 tonnes, respectively. If the above figures, reflecting the use of DDT, are correct it would mean that the volume of DDT export was high and exceeding as much as 3000 tonnes per year.

Aldrin was used in very small quantities: 19.2–10.5 tonnes only in 1962. It was admitted for use and imported.

It is also known, that in 1965 as much as 91 out of 190 preparations (about 50%) were chloroorganic compounds. During the following years this quantity was declining and reached only 20% in 1994. Unfortunately, this information cannot be directly related to POPs because preparations such as for instance, MCPA and 2,4-D, which also are chloroorganic compounds, are still being used. Dtermination of their share in the group of chloroorganic compounds is practically impossible.

Table 2.2. List of domestic pesticide preparations admitted for use and the content of declared share of active substances

Name of preparation (original)	Producer	% of active substance
DDT		
Azotox powder 5 *(Azotoks pylisty 5)*	Ch.W. AZOT	5% DDT; 0.1% γ-HCH
Azotox liquid 10 *(Azotoks płynny 10*	Ch.W. AZOT	10% DDT
Azotox liquid 30 *(Azotoks płynny 30)*	Ch.W. AZOT	33% DDT
Azotox liquid 40 *(Azotoks płynny 40)*	Ch.W. AZOT	40% DDT
Azotox 50 for suspensions *(Azotoks 50 do zawiesin)*	Ch.W. AZOT	50% DDT
Azotox liquid 25 *(Azotoks płynny 25)*	Ch.W. GAMRAT	25% DDT
Azotox powder active *(Azotoks pylisty aktywny)*	Ch.W. AZOT	5% DDT; γ-HCH; DMDT
Ditox *(Ditoks)*	Ch.W. AZOT	5% DDT; 0.3% γ-HCH
Ditox L *(Ditoks L)*	Ch.W. AZOT	4.7% DDT; 0.3% γ-HCH
Ditox 30 *(Ditoks 30)*	Ch.W. AZOT	18% DDT; 2% γ-HCH
Fumatox DG *(Fumatoks DG)*	Ch.W. AZOT	30% DDT; 3% γ-HCH
Kornikol	Ch.W. AZOT	2% DDT; 7% HCH; 2% DNOC
Lasochron	Ch.W. AZOT	10% DMDT; 7% DDT; 10% HCH
Mgławik 10	Ch.W. AZOT	8% DDT; 5% γ-HCH
Mgławik 15	Ch.W. AZOT	10% DDT; 2% γ-HCH
Tritox powder *(Tritoks pylisty)*	Ch.W. AZOT	1.5% DDT; 0.5% HCH; 2% DMDT
Tritox liquid 30 *(Tritoks płynny 30)*	Ch.W. AZOT	10% DDT; 5% γ-HCH; 14% DMDT
Tritox liquid for suspensions *(Tritoks płynny do zawiesin)*	Ch.W. AZOT	45% DDT; 2% γ-HCH; 3% DMDT
Tritox powder *(Tritoks pylisty)*	Ch.W. AZOT	1.5% DDT; 0.5%HCH; 2% DMDT
Tritox liquid 30 *(Tritoks płynny 30)*	Ch.W. AZOT	10% DDT; 5% HCH; 14% DMDT
Tritox liquid for suspensions *(Tritoks płynny do zawiesin)*	Ch.W. AZOT	45% DDT; 2% γ-HCH; 3% DMDT
Preparations based on DDT were gradually withdrawn from use since 1972. Lasochron (for forest protection), used longest, was allowed for the last time for sale in 1975.		
DIELDRIN		
Dieldrin mixture	Ch.W. AZOT	2.7% pure dieldrin
Preparations containing dieldrin have been withdrawn from turnover after 1975.		
HCB		
Śnieciotoks 40	Ch.W. AZOT	40% hexachlorobenzen
The *Śnieciotoks* preparation was admitted for the turnover for the last time in 1978 with a footnote "until exhaustion of stocks".		
TOXAPHENE		
Kamfochlor	Ch.W. AZOT	10% chlorinated camphene
Liquid Terpentol *(Terpentol płynny)*	ROKITA	60% chlorinated terpenes
Liquid Terpentol was admitted for turnover for the last time in 1970, and Kamfochlor in 1971.		

Table 2.3. Production structure of preparations containing DDT during 1965–1970 [tonnes]

Name of preparation (original)	Years					
	1965	1966	1967	1968	1969	1970
Azotox powder 5% *(Azotoks pylisty 5%)*	4061	2084	15 793	1163	715	578
Azotox liquid 25% *(Azotoks płynny 25%)*	150	317	826	1051	230	501
Azotox suspension 50% *(Azotoks zawiesinowy 50%)*	347	259	283	289	293	243
Ditox *(Ditoks)*	53 637	58 345	40 343	21 113	34 123	27 735
Tritox powder *(Tritoks pylisty)*	5721	3777	3953	3417	3493	6542
Tritox liquid 30% *(Tritoks płynny 30%)*	935	976	1240	1157	2287	2996
Tritox suspension *(Tritoks zawiesinowy)*	45	197	255	348	787	272
Mgławik	355	592	677	723	750	334

As it can be concluded from data presented in the above tables, from among substances subject to the Stockholm Convention, the following were used as active substances by the Polish chemical industries for the production of pesticides:

- DDT,
- Dieldrin,
- Hexachlorobenzene, and
- Toxaphene.

Dieldrin and hexachlorobenzene were not produced by the enterprises of the Polish chemical industry. Dieldrin was presumably imported in the form of a 90% concentrate and processed into a commercial dieldrin mixture containing 2.7% of pure dieldrin.

Preparations, covered by the Stockholm Convention, such as aldrin, chlordane, endrin, heptachlor and mirex were not applied by the Polish industries for pesticide production. The latter was applied in negligible amounts in experimental activities on plant protection chemicals.

Preparations, containing POPs covered by the Stockholm Convention were produced only by three Polish chemical industries: Chemical Works AZOT in Jaworzno, Chemical Works GAMRAT in Jasło and the Organic Industries ROKITA in Brzeg Dolny.

However, two preparations subject to the Stockholm Convention were produced and processed in Poland:

- DDT produced by the AZOT works in Jaworzno under the name of *Azotoks*,
- Toxaphene produced by the ROKITA works as chlorinated terpene and by the AZOT works as chlorinated camphene. However, no records are found in statistical yearbooks for the production of chlorinated camphene. It can be then assumed that further processing of imported, more concentrated, camphene preparations into another product took place.

Import of pesticide preparations. Pesticide preparations were imported in the years 1961–1978 from European countries such as Austria, Denmark, the Netherlands, Yugoslavia, GDR, FRG, Switzerland and the United Kingdom. Detailed information concerning that import is presented in Table 2.4.

As Table 2.4 proves, there was no import of preparations containing chlordane, hexachlorobenzene or mirex, subject to the Stockholm Convention. This table provides only quality data of the imported preparations. No information is available on the imported quantities (apart from the above mentioned aldrin).

2.1.4. Production of chloroorganic compounds resulting in unintentional generation of PCDDs, PCDFs, HCB and PCBs

Unintentional production of these compounds is demonstrated by contamination of products, equipment and production installations. Processes of chlorination of organic compounds in Poland were performed in 8 chemical factories and in 7 of them the electrolysis of rock salt was conducted. Five of the latter ones performed these processes applying the, so-called, mercury electrolysis using carbon electrodes.

Chlorination of the following chemical raw materials took place in the Polish industry:

- Chlorination of methane aimed at production of methyl chloride, methylene chloride, chloroform and carbon tetrachloride; this process was carried out in one of the enterprises,
- Chlorination of aromatic hydrocarbons and their derivatives (benzene, nitrobenzene, biphenyl); these processes were implemented in 6 enterprises,
- Chlorination of phenol and its derivatives (cresol) was performed by 2 enterprises.
- Chlorination of acetylene, aimed at production of trichloroethylene, perchloroethylene and vinyl chloride was conducted in 3 enterprises,
- Chlorination of olefin (ethylene and propylene) for the production of solvents (carbon tetrachloride, perchloroethylene), allyl chloride, dichloroethane and subsequently, vinyl chloride was performed by 3 enterprises.

No comprehensive investigations aimed at determination of POPs content in products obtained in chlorination processes and in their waste by-products have been carried out in Poland so far.

Table 2.4. List of imported pesticide preparations allowed for use in Poland and the declared shares of active substances contained therein.

Name of preparation (original)	Producer	% of active substance
1	2	3
ALDRIN		
Aldrin 2.5	Schering (FRG) Nordisk Alkali (Denmark)	2,5% aldrin
Aldrin 5	Schering (FRG) Chromophos (Yugoslavia)	5% aldrin
Arrex M	CELA (FRG)	8% aldrin; 25% endrin
Argonex TA	CELA (FRG)	22,3% aldrin; 49% thiuram
Liro Thiraldin	Ligtermoet Zoon	23% aldrin; 48% thiuram
Preparations containing aldrin were not admitted for marketing in Poland after 1975.		
DDT		
Duolit powder 5	VEB Tettchem (GDR)	5% DDT
Duolit liquid 20	VEB Fettchem (GDR)	20% DDT
Pentacid Doliden Kerfec C	Kemikalia (Yugoslavia)	4.7% DDT; 0.4–0.5% γ-HCH
Ring Deksol	VEB Bitterfeld (FRG)	6% DDT; 5% γ-HCH
Preparations, based on DDT were gradually withdrawn from use since 1972. This withdrawal was completed in 1975.		
DIELDRIN		
Alvit 55	Schering (FRG) Nordisk Alkali (Denmark)	90% technological dieldrin
Dieldrex B	Shell (United Kingdom)	75% dieldrin; 10% thiuram
Binasin	Merck (FRG)	dieldrin
Colotox	Sandoz (Switzerland)	1% dieldrin; 8% Cu compounds
Preparations containing dieldrin have been withdrawn from marketing after 1975.		
ENDRIN		
Arrex M	CELA (FRG)	8% aldrin; 25% endrin
Preparation banned for marketing in 1972.		
HEPTACHLOR		
Agronex hepta	CELA (FRG)	25% heptachlor
Preparation was allowed for sale only in 1966.		

1	2	3
TOXAPHENE		
Liro Toxaphene 10	Ligtermoet Zoon (Netherlands)	10% chlorinated camphene
Melipax Spritzmittel (liquid)	VEB Fahlberg list (GDR)	60% chlorinated terpenes
Melipax Staub (powder)	VEB Fahlberg list (GDR)	10% chlorinated terpenes
Melipax Aerospruhmittel (for fogging)	VEB Fahlberg list (GDR)	40% chlorinated terpenes
Toxaphene 50	Serum Zavod Kalinovia (Yugoslavia)	50% chlorinated camphene
Toxaphene 10	Merck, Schacht (FRG)	10% chlorinated camphene
Toxaphene 10	Luxan (Netherlands)	10% chlorinated terpenes
Toxaphene 10	Ligtermoed Zoon-Luxan (Netherlands)	10% chlorinated terpenes
Toxaphene 10	Linz (Austria)	10% chlorinated terpenes
Toxaphene 20	Merck, Schacht (FRG)	20% chlorinated camphene
The imported preparations containing toxaphene (Melipaxes produced in GDR) were banned for sale in 1987. Other preparations were withdrawn earlier, most of them after 1971.		

2.2. PRESENT SITUATION

Since the end of the seventies of the 20th century no substances classified as persistent organic pollutants subject to the Stockholm Convention, have been produced intentionally by the Polish industry. Hence, these substances are not, except for PCBs, subject to export. The existing export includes discarded electric appliances filled with mineral oil with addition of polychlorinated biphenyls or with pure PCBs with the aim of safe treatment. The domestic capacity for treatment of PCBs and PCB contaminated appliances is being developed, thus the volume of such export will also gradually go down.

Substances included in the annexes of the Stockholm Convention are not produced, used, imported nor exported by Poland. This issue is regulated by the Law on Cultivated Plant Protection[1] and the Regulation of the Minister of Agriculture and Rural Development[2] of 5 March 2002 on detailed rules for issuing of permits, admitting

[1] Dz.U. 1995 No. 90, item 446; as amended.
[2] Dz.U. 2002 No. 24, item 250; as amended.

plant protection chemicals for marketing and use. Annex 9 of that regulation "Biologically active substances banned from use as constituents of plant protection chemicals in Poland" includes all biologically active substances of plant protection covered by the Stockholm Convention. The regulations mentioned above are the continuation and amendments of relevant regulations introduced in 1961.

Ever since, only substances and preparations without POPs have been used for production of pesticides.

A deep reconstruction of chloroorganic compounds' production processes took place in the Polish industry in the past and is still continued. Mercury electrolyses of rock salt have been discontinued in two enterprises. In the remaining works carbon electrodes were replaced some 15 years ago by uniform titanic electrodes. The process of methane chlorination has been eliminated from the production profile as well as a considerable part of acetylene chlorination processes and methane chlorination to perchloroethylene and carbon tetrachloride. Chlorination processes have been definitely phased out in three chemical works. PCBs have been entirely eliminated from production and operation and replaced by hexachlorobenzene in the polyvinyl chloride and solvent complex practically completely reduced. The remaining chlorination processes have been radically modernized in all chemical works. Processes of safe treatment have been developed in enterprises applying chlorination of organic compounds processes. This has substantially reduced the unintentional generation of such pollutants as PCDDs, PCDFs, PCBs and HCB.

3. POPs STOCK, RESIDUES AND WASTE. CONTAMINATED AREAS

3.1. OBSOLETE PESTICIDES AND PESTICIDE WASTE IN LANDFILLS

Elimination of pesticide waste through land filling is not legally prohibited. The most serious POPs threat to the environment in Poland comes from the waste of unused plant protection chemicals, deposited in countrywide dispersed stockpiles in the form of underground silos built of concrete cases, of 1–2,5 m in diameter treated with tar, ca 3 m deep with a concrete bottom, known as "pesticide tombs" or "pesticide landfills" as named by respective EU regulations. The latter term will be used in this report. These facilities, built and used during 1965–1985, turned out to be unsafe. Affected by corrosion, they became a source of contamination of underground water and the surrounding ground layers. Pesticide and herbicide waste is also stored directly (packaged) in ground ditches, military bunkers from the World

War 2 and concrete containers. Wastes from packing material of pesticides as well as other hazardous waste were also deposited there.

Pesticide landfills were set up in the past by state farms, which used to gather reserves of plant protection chemicals, and later on, in result of withdrawal of some of them from use, disposed such pesticides into pesticide landfills. A considerable share in the construction of pesticide landfills had also the unions of rural trading co-operatives PZGS as distributors of plant protection chemicals. Liquidation of state farms and trading co-operatives impedes the inventory and reclamation activities of such sites. In most instances, lack of information on the contents of pesticide landfills and on the extent of application of pesticides, containing substances being subject to the Stockholm Convention, suggest that the whole amount of waste deposited in pesticide landfills is contaminated with POPs to such a degree that it should be treated as hazardous substances containing organic halogen derivatives.

Data on the number of pesticide waste dumping sites are varying, depending on the source of information. Information according to the Environmental Protection Inspection (EPI) and in accordance with the National Waste Management Plan (NWMP) as well as the latest information of the State Geological Institute is summarised in Table 3.1. The list of pesticide landfills and other dumping sites of pesticides (industrial waste landfills, ground ditches, concrete containers, military bunkers) prepared by A. Siłowiecki from the Institute of Plant Protection, Sośnicowice Branch, contains 303 entries. According to that list, shown in Annex 2, the quantity of waste dumped in pesticide landfills and elsewhere amounts to 5065 tonnes, though no information is available about the quantity of waste dumped on 53 sites, including the landfill of the Chemical Works AZOT in Jaworzno estimated to hold 14000 tonnes of waste containing chloroorganic substances.

According to NWMP 340 there are pesticide landfills in Poland, where outdated plant protection chemicals have been deposited since 1965. In NWMP the amount of 15000 tonnes of pesticide waste has been recognised as dumped in pesticide landfills and kept in storehouses[3].

Due to the shortage of reliable information concerning the quantities of outdated pesticides in pesticide landfills and stores, the State Geological Institute, on request of the Ministry of the Environment, carried out inventory activities and investigated the impact of pesticide landfills on the ground as such and on the underground aquatic environment. In result of these activities, in 2003 the national database on pesticide landfills was developed (with specification of their co-ordinates on the GIS grid).

[3] Stocks of outdated plant protection chemicals under administration of the regional State Forest Directorates have also been identified.

Table 3.1. Number of pesticide landfills in each voivodeship (as of 31.12.1999)

Voivodeship	Pesticide landfills located over main underground water reservoirs, acc. to EPI		Remaining pesticide landfills, according to EPI		Pesticide landfills total, according to NWMP		Pesticide landfills total, according to SGI (as of 2003)	
	Ground ditches	Built objects	Ground ditches	Built objects	Total	Incl. eliminated pesticide landfills	Total	Incl. eliminated pesticide landfills
Dolnośląskie	0	6	0	3	9	0	9	1
Kujawsko-Pomorskie	0	3	1	16	23	5	23	5
Lubelskie	0	12	0	1	16	16	16	16
Lubuskie	0	0	0	3	7	1	6	6
Łódzkie	5	5	0	16 (+2)	34	0	31	0
Małopolskie	1	3	5	3	27	0	27	0
Mazowieckie	2	5	0	5	22	1	12	1
Opolskie	0	3	0	1	4	0	4	2
Podkarpackie	9	6	5 (+1)	4	26	6	26	25
Podlaskie	0	3	0	5 (+1)	6	3	6	3
Pomorskie	0	1	0	6	8	1	8	3
Śląskie	2	4	0	5	11	3	11	3
Świętokrzyskie	1	3	8	5	22	2	22	14
Warmińsko-Mazurskie	0	7	0	9	17	0	17	0
Wielkopolskie	0	12	2	13	27	1 (partly)	27	14
Zachodniopomorskie	0	10	0	28	39	11	39	12
Total	**20**	**83**	**21 (+1)**	**123 (+3)**	**298**	**50**	**284**	**105**

Numbers in brackets – lack of data on type of pesticide landfill.

All pesticide landfills should be removed and their sites cleaned up. Priority should be given to those objects, which are located at sites geologically unfavourable and as such polluting strongly the natural ground and ground water environment.

The National Waste Management Plan places at the top of priority actions the need to complete the inventory of sites where outdated pesticides are stored or dumped and the development of the list of sites which are most hazardous to the environment.

In several voivodeships the following amounts of outdated pesticides stockpiled in pesticide landfills were identified:

- Małopolskie 10.7 tonnes
- Podkarpackie 152 tonnes
- Podlaskie 9.7 tonnes
- Warmińsko-mazurskie 32.7 tonnes
- Zachodniopomorskie 0.4 tonnes

Apart from their storage in pesticide landfills, the outdated plant protection chemicals, including those which contain POPs, remain also in the stores of trade organisations and pesticide users. Considerable quantities are piled up in the stores of Regional Directorates of State Forests. The earlier investigations indicate that during 1999–2000, the amount of 650 tonnes of outdated pesticides was eliminated in the Lubelskie Voivodeship.

3.2. CONTAMINATION OF SITES SURROUNDING PESTICIDE LANDFILLS

Ground contamination by POPs, caused by plant protection chemicals, has been noted at some of the dumps (pesticide landfills) of waste of obsolete and forbidden pesticides. Contamination is found mainly at the topsoil layers and sporadically in deeper strata caused by POPs migration with penetrating water flows.

According to inventories conducted by the State Geological Institute in a few cases penetration of ground waters into the landfills could have taken place. Also, incidents of flooding the pesticide landfills could occur during the past floods, particularly in 1997, though reliable information in this respect was not available. It is also known that pesticide landfills were not located on flood-lands.

For the NWMP, it is assumed that for every 1 m^3 of pesticide waste, 4 m^3 of POP contaminated ground has to be handled during the clean-up operation. It seems that this value is exaggerated and it results from the experience gathered so far

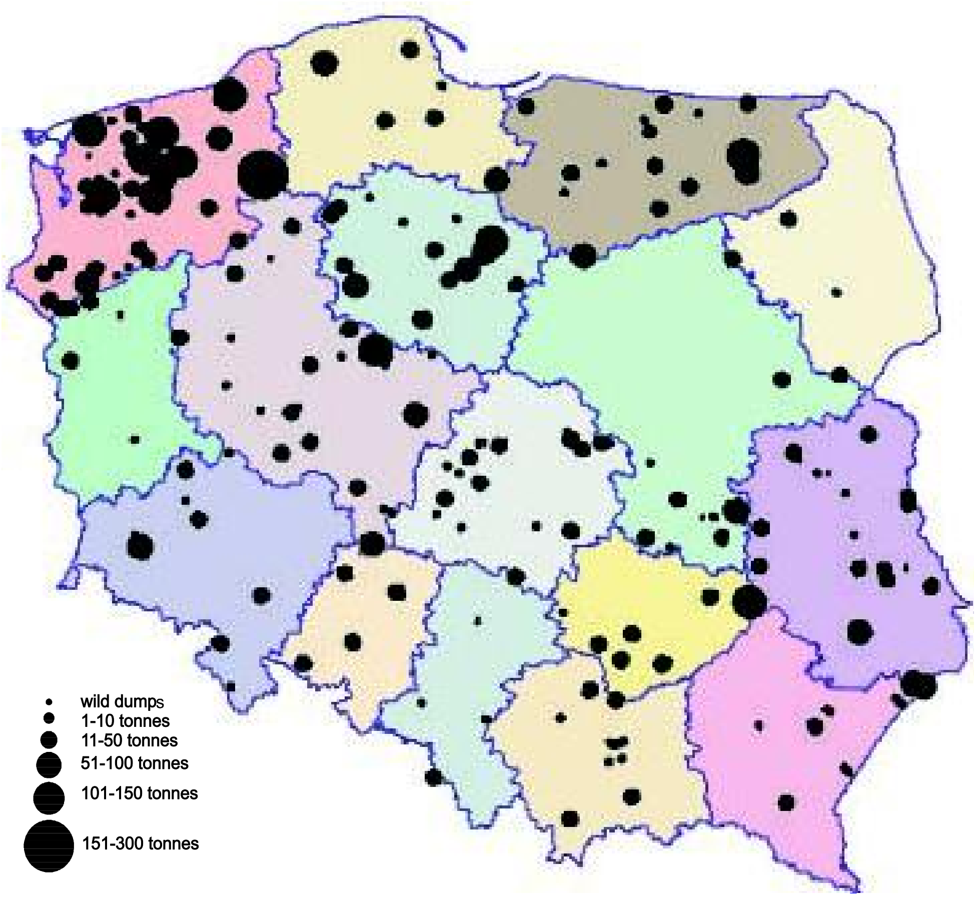


Fig. 3.1. Location of pesticide landfills in Poland at the background of the current administrative division into 16 Voivodeships. Pesticide landfills were classified according to the amount of deposited waste.

from pesticide landfills' liquidation activities. It is known that sites cleaned up in the past demonstrated heavy contamination of the areas surrounding the silos.

Table 3.2. shows that 43 pesticide landfills were investigated for underground water pollution[4] (14.3%), and 32 for soil contamination (10.6%). This is not a sufficient number to assess the degree of ground contamination by POPs.

[4] Including water intakes in the neighbourhood.

Table 3.2. Number of pesticide landfills and the state of research on pollution of ground water and soil at their sites

Voivodeship	Number of pesticide landfills		Investigation of site contamination					
			Ground water			Soil		
	Total	Ground ditches	Total	Pollution		Total	Pollution	
				Yes	No		Yes	No
Dolnośląskie	11	1	0			1		1
Kujawsko-pomorskie	23	3	5		5	8	5	3
Lubelskie	14	0	3	1	2	3	2	1
Lubuskie	7	0	0			0		
Łódzkie	30	9	4		4	1		1
Małopolskie	28	20	1		1	1		1
Mazowieckie	12	2	0			1		1
Opolskie	5	0	3		3	3		3
Podkarpackie	32	24	1		1	0		1
Podlaskie	10	0	0			0		
Pomorskie	7	0	3		3	2	1	1
Śląskie	12	0	3		3	1		1
Świętokrzyskie	30	20	10	1	9	6		6
Warmińsko-mazurskie	16	1	1		1	2	1	1
Wielkopolskie	27	5	3		3	2		2
Zachodniopomorskie	39	0	9	1	8	0		

Source: Institute of Plant Protection (according to data presented in Annex 2).

3.3. LANDFILLS OF INDUSTRIAL WASTES CONTAINING PESTICIDES

Since 1966, the lists of plant protection chemicals permitted for marketing were published by the *Dziennik Urzędowy Ministerstwa Rolnictwa* (Official Gazette of the Ministry of Agriculture)[5]. Table 3.3, compiled on the data from those lists, provides information about periods during which preparations containing POPs were applied.

Data of the Table 3.3 allow to assess the age of unused preparations found in a smaller part in storage houses but mainly on waste landfills, as described under item 3.2.

[5] Until the beginning of the 90s, except for 1981–1983, information about the usable form, composition and the producer was given.

Table 3.3. Period during which plant protection chemicals containing substances covered by the Stockholm Convention provisions were permitted for marketing

Name of substance	Period of permitted marketing
Aldrin	until 1975
Chlordane	not permitted for marketing in Poland
DDT	gradually withdrawn since 1972 – the last preparation was admitted in 1975
Dieldrin	until 1975
Endrin	until 1972 mixed with Aldrin (Arrex M)
Hexachlorobenzene	until 1978 (note: „until exhaustion of stocks") presents a product of decomposition of Quintocene, permitted until 1986
Heptachlor	only in 1966
Mirex	not permitted for marketing in Poland
Toxaphene	withdrawal began in 1970 (in 1971 domestic production abandoned); imported preparations withdrawn since 1987

During the 70s and 80s only about 1 kg/ha of pesticides in average was used in Poland. Compared to the countries of Western Europe this level was rather low.

The problem of POP-containing waste, resulting from production of active substances, is limited in Poland to one factory – the Chemical Works AZOT in Jaworzno. This enterprise has been the greatest producer of plant protection chemicals in Poland since 1947. Among others DDT was produced here, output of which during the second half of 1960s was equal to the total domestic production of active substances of pesticides.

According to data of the Inspection for Environmental Protection, wastes of the Chemical Works AZOT were and still are deposited primarily on the closely neighbouring Central Waste Landfill RUDNA GÓRA. The area of the landfill is approximately 11 hectares, 6 m deep at the sub-horizon part and 5 m high at the over-horizon part. The total amount of accumulated waste is estimated at about 250 thousand tonnes. The date of the landfill's starting is not known, but its oldest part, the so-called "field K" was closed for dumping in 1972, and some other parts were subsequently opened. Inactive parts of the landfill were gradually cleaned up. It should be mentioned that wastes were not stapled on the landfill in a manner reflecting the current requirements of selective storage.

According to the information of the chemical works, in the oldest parts of the landfill wastes with DDT, presenting a mixture of isomers containing about 75% of 4,4-dichloro-diphenyl-trichloroethane, were deposited. A similar situation is relevant for other works, where wastes containing hexachlorobenzene could have been dumped in the past.

At the ANWIL works two landfill sections are used for deposition of hazardous waste. The first one, about 4 hectare large and of about 70 000 m^3 volume was opened, after modernisation, in 1998. The second one, of 1.2 hectares and 42 000 m^3 in size, was opened in 1996. Both sections are already partly filled. Previously, other fields, which are now closed and reclaimed, were exploited. Under such circumstances, it is difficult to determine where possible deposits of HCB could be found. It is worth mentioning that a control of ANWIL landfills carried out in 1999 by the Voivodeship Inspection for Environmental Protection in Bydgoszcz did not reveal any irregularities in their management. This can also be true in relation to environmental impacts on the landfill surroundings.

The Chemical Works ORGANIKA in Sarzyna are now using a landfill, of 0.23 hectares and 9000 m^3 in volume, opened in 1991. It has been filled by about 50%. No information is available on previous waste dumping sites.

The Nitrogen Works in Tarnów-Mościce have two landfills at their disposal: NAD BIAŁĄ and CZAJKI of an active, unused and reclaimed area of 6.85 hectares and 350 000 m^3 in volume. In addition, they also have also 3 containers of 111 000 m^3 for toxic waste, which are partly filled. In 1999 close to 23% of all waste disposed of in the Małopolskie Voivodeship was accumulated on these landfills (according to the Voivodeship Inspection for Environmental Protection in Kraków).

It can be concluded from the above that identification and quantitative assessment of possible deposits of POPs on landfills managed by industrial enterprises is not possible. Sites, where such substances could have been dumped in the past, are not known, or already reclaimed or covered by layers of other wastes, including hazardous waste generated after abandoning POPs production. The share of POPs in the total mass of land filled wastes is negligibly small. Further activities on the inventory of landfills and identification of their content are necessary.

Investigations carried out so far indicate that removal of possible POPs residues, deposited on the landfills of enterprises where in the past specific chemical products were manufactured, is not feasible. In this case, apart from lack of possibility to locate the residues, the decisive factor is presented by the environmental risk connected with the destruction of the structure of landfills, most of which are reclaimed and do not cause negative environmental impacts.

No data on site contamination by POPs are available. The only reliable information in this respect reflects the state of water contamination tested systematically at the AZOT works. Presence of DDT was found in landfill leaches, underground waters of the surrounding area and in the Wąwolnica stream water. Concentration of that compound varied at different times and sites of measurement. Maximum DDT concentration was found in waters of the landfill-draining ditch. In 2001 DDT concentration oscillated between 15.8 and 43 mg/l. It may be interesting to mention that the top value of the legally permitted pollution load in wastewater discharged into waters and into the ground should not exceed 0.5 mg/l[6]. In the underground water as well as in water of the Wąwolnica stream, DDT was periodically present.

The Chemical Works GAMRAT, which produce preparations from ready compounds, hence, applying a wasteless technology could accumulate just packages from active substances on landfills, constituting rather minor hazards.

The Chemical Works AZOT in Jaworzno, the Organic Industries ROKITA in Brzeg Dolny and the ANWIL in Włocławek have their own waste incinerators, used for treatment of useless remainders of production processes. The processing capacity of the incinerator in Włocławek exceeds its own requirements of the factory and can be used for destruction of other toxic substances.

3.4. PCB-CONTAINING WASTE

Polychlorinated biphenyls (PCBs) were produced in Poland in small amounts, while polychlorinated terphenyls (PCTs) have never been produced. However, importation of those substances was considerable as they were used as components of oils in electro-technical installations. Such installations, containing the above-mentioned substances, were also imported. Neither PCBs nor PCTs are currently used in new installations produced domestically or imported. A number of installations containing PCBs remain still in use.

Preliminary inventory performed in the South-Western Poland during 1995–1996 under guidance of M. Rutkowski covered 380 facilities. Results are presented in Table 3.4.

More reliable was the review of PCB stocks carried out in 2001, with the aim of preparing the implementation plan for Directive 96/59/EC on the disposal of PCBs and PCTs.

Results of this review are given in Table 3.5 and show the number of installations and PCB-containing waste and directions of their disposal. Data of that table do

[6] Regulation of the Minister of the Environment of 29 November 2002 on conditions required for wastewater quality discharged into waters or into the ground as well as on dangerous substances for aquatic environment (Dz.U. No. 212, item 1799).

Table 3.4. Results of PCB sources' inventory in South-Western Poland

Installations	Quantity	Oil content [tonnes]
Transformers, including the ones with PCB	24 674 69	25 720.9 85.1
Capacitors, including the ones containing PCBs: • in use • discarded	34 055 11 004 611	317.3 109.4 3.6
Other electric power installations	18 340	2749.9

Source: "Development of environmental prevention system against contamination by PCB compounds in Poland", Wrocław University of Technology, Institute of Petroleum and Coal Chemistry and Technology (1995–1997).

not reflect the present situation concerning waste but provide indicative quantities of waste likely to appear after complete withdrawal of PCBs from use (in accordance with the EU Directive 96/59/EC). Information about the quantities of PCB-contaminated oil refers to the residues stockpiled by electrical power facilities after oil change, which were not classified as waste and remain in storehouses as materials withdrawn from commercial turnover.

Similar estimates are presented by the National Waste Management Plan.

The Environmental Protection Law[7], introduced a ban on marketing and reuse of PCBs. This law and the new Waste Law[8] as well as the issue of executive regulations in 2002 gave, at the end of 2000, legal basis for the collection of official data on the quantity, types and locations of PCBs.

The Regulation of the Minister of Economy of 24 June 2002 on requirements concerning the use and the movement of substances constituting particular environmental threat as well as the use and the cleaning of installations or appliances in which substances constituting particular environmental threat were or are used[9], has imposed on the owners the duty to complete inventories of PCB-containing equipment by the end of 2002. This obligation applies to all the equipment containing not less than 5 dm^3 of PCB with a concentration equal to or greater than 0.005% by weight. Regulation of the Minister of Economy of 26 September 2002 determining types of installations, in which substances constituting particular

[7] Dz.U. 2001, No. 62, item 627; as amended.
[8] Dz.U. 2001, No. 62, item 628; as amended.
[9] Dz.U. 2002, No. 96, item 860.

Table 3.5. Estimated quantities of PCB waste and PCB polluted equipment, according to the implementation plan of the 96/59/EC Directive

Particulars	Mass [tonnes]	Origin	Method of disposal
PCB-contaminated oil	3000	Oil drained from transformers – 1000 tonnes. Oil drained from eliminated transformers and other equipment (switches, rectifiers, etc.) – 1000 tonnes. Waste oils and fluids from decontamination processes – 1000 tonnes	Incineration in an installation for destruction of liquid chloroorganic compounds
Capacitors and other equipment requiring neutralisation	7620	250 000 used and rejected capacitors, weighing in average 30 kg each – installed and discarded – 7500 tonnes, non-metal materials from discarded capacitors (paper, wood etc.) – 120 tonnes	Incineration in an installation for destruction of liquid chloroorganic substances
Transformers and other equipment requiring decontamination	3500	1000 transformers, drained of oil, non-metallic parts detached – 3000 tonnes, metal parts of switches, rectifiers etc. – 500 tonnes	Decontamination

environmental threat[10], specific PCB-containing installations, the year of their production and the producer are indicated.

From the implementation of these regulations, the Voivodeship authorities could acquire information about such installations, most of them still in use (or standing by). On the basis of that information, a compilation of PCB-containing installations in individual Voivodeships has been prepared (Table 3.6).

Fragmentary inventories are distinctively showing that electro-technical installations containing PCBs are practically found at each industrial sector, from power industry to food processing industry (sugar factories). These installations are mostly descending from the 70s, but dated earlier (since the 60s) and occur also later (in the 80s). Their producers not always would label the appliances with information about PCB content, which makes the ultimate identification more difficult.

[10] Dz.U. 2002, No. 173, item 1416.

Table 3.6. PCB-containing installations still in use or standing by in 2002 (without discarded equipment or waste) [kg]

Voivodeship	Type of installation			
	Transformers	Capacitors	Other	Unidentified
Dolnośląskie	346 102	39 077	709	–
Kujawsko-pomorskie	42 057	29 471	279	–
Lubelskie	145 892	31 226	6 409	–
Lubuskie	14 820	4 433	0	–
Łódzkie	83 793	51 778	3 895	–
Małopolskie	1 343 449	258 298	8 119	944
Mazowieckie	114 150	37 159	4 306	–
Opolskie	600 933	46 721	3 624	–
Podkarpackie	628 366	174 416	189	–
Podlaskie	215 562	48 656	7 416	–
Pomorskie	635 981	62 180	2 100	–
Śląskie	651 744	333 616	42 913	–
Świętokrzyskie	239 031	122 250	18 377	–
Warmińsko-mazurskie	225 591	9 779	4 752	–
Wielkopolskie	213 388	61 379	3 261	259 638
Zachodniopomorskie	36 165	67 046	36	–
Total	**5 537 024**	**1 377 485**	**106 385**	**260 582**

Therefore, screening tests should practically be applied to all types of electro-technical installations of individual producers, which contain dielectrical fluids. More complete assessment of PCB quantities remaining under control of enterprises as well as individuals will be possible by mid 2004, after data for 2003 become available.

The review of particular inventory reports shows that the capacitors, the number of which is much greater and the dispersion larger, constitute a greater problem, both from quantitative and technical points of view.

In technical terms, no difficulties should appear from the necessity to perform screening tests of the functioning and unused installations containing PCBs or “suspected” to contain them. Polish laboratories of the research and development centres and some of the Voivodeship Environmental Protection Inspection take measurements of PCBs. A significant issue in this respect might be the necessary financial inputs. Estimates show that preliminary investigations on PCB presence should include about 400 thousand capacitors and other electro-technical equipment, operated and discarded, out of which some 10 thousand pieces will require detailed analyses of PCB contained therein. Also, about 10 thousand capacitors will require to be tested for PCB content. The cost of that operation is estimated at about 40 million PLN. Considering that these costs – though not negligible – will have to be born by the owners of the equipment in question, it seems to be justified to support the inventory and identification action by special financial means, to avoid hiding possession of such installations in order to escape undesirable costs.

In this situation, it seems worth considering, particularly after a decontamination facility in Poland becomes available, to order the equipment to be sent for treatment on assumption, without testing it. Such procedure should refer particularly to capacitors, switches (small volumes) and small transformers.

Information about application of PCBs/PCTs for other purposes than for electro technical installations is not available.

Methods of decontamination and elimination of PCBs will be presented in technical reports to be developed during the National Implementation Plan Development Phase.

4. AIR EMISSION OF PERSISTENT ORGANIC POLLUTANTS

4.1. INTRODUCTORY INFORMATION

An assessment of the emissions of persistent organic pollutants (PCDDs/PCDFs, PCBs and HCB) into the air carried out in the year 2000 was performed according to the classification of emission sources provided by the Selected Nomenclature for Air Pollution (SNAP) scheme. It distinguishes 11 main categories of emissions subdivided into over 400 detailed sub-categories. The SNAP classification of emission sources is used for reporting on emissions by each country to the Secretariat of the UN Economic Commission for Europe and to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). Application of that scheme ensures consideration of all significant emission sources, on which the reporting country has relevant information (emission factors and data on respective activities) and allows comparing and analysing emission data from different countries.

An inventory of emissions is performed in Poland on the basis of two data sets:

- The national statistical data published by the Central Statistical Office (GUS), concerning the use of fuels and raw materials, the annual output of industrial products or other values (so-called activities), characterising the volume of the given sector's activities.
- Data presenting emission indicators, national or drawn from relevant literature, which reflect the level of particular pollutant's emission per production unit or unit of fuel used.

The emission from a particular source is calculated as activity value multiplied by the emission factor relevant to that activity. For instance, the PCB emission from burning timber in the dwelling and services sector (SNAP 0202) is calculated by multiplying the quantity of the timber burned (in thousand tonnes) and the factor of PCB emission per unit of timber mass (g/tonne; see Table 4.1).

Statistical data on activities, taken from GUS, have been adapted to the required scheme of reporting, which often needed an expert evaluation, concerning proper subdivision within the separate SNAP categories. Where data published by GUS were insufficient, other information, from credible and well-documented sources has been used.

Apart from factors taken from literature, also the national factors for POPs emission were applied for inventory purposes. The latter ones are based on measurements performed by the Trace Analysis Team of the Kraków Technical University, Institute of Chemistry and Inorganic Technology. Measurements of PCDD/PCDF, PCB and HCB emissions were carried out – within the framework of the GF/POL/01/004 Project – in two sintering plants (being the only two sintering plants of iron ores in Poland), two cement factories and two hazardous waste incineration plants (including hospital waste).

4.2. EMISSION OF POLYCHLORINATED BIPHENYLS

The latest literature data published by the European Commission indicate that the main sources of PCB emissions into the air are the leakages from capacitors (70–90% of total emission). The remaining sources, still regarded as significant, are: steel production in arc furnaces (5–10%), cutting scrap into pieces (2–6%), coal burning (2–6%), burning heating oil (1–3%), leakages from transformers (1–3%), farm land fertilisation with sewage sludge (1–3%), steel production in other furnaces (0.5–2%) and production of sinters (0.1–0.5%). The share of emission from other sources does not exceed 0.5% of the total emission into the air.

According to the performed evaluations, the annual PCB air emission in Poland for the year 2000 was 2320 kg (Table 4.1). Diagram 4.1 presents shares of the specific sectors in the countrywide emission. The dominating sources of PCB emissions, responsible for 71% of the total emission in Poland, are the electric power engineering facilities, in particular the capacitors filled with impregnates containing PCB. This, presumably the main source of PCB emissions, is classified as SNAP 060507. The remaining significant sources are the combustion processes in the municipal and dwelling sectors (15% of countrywide emission) as well as the road transport and power generation and transformation sectors (each of these sub-sectors is responsible for 5% of the total national PCB emission). Subject to SNAP 02, definitely the highest share in air pollution emission goes to burning timber and hard coal in the dwelling and services category (0202).

New emission sources were included in the PCB emission inventory, for which relevant emission factors could be established either from measurements carried out in Poland (see box below) or from available literature factors. Factors were changed within the SNAP 01-03 category. This is connected with the discrimination of combustion conditions, which are different in the public power industry as compared with the municipal and dwelling sectors, where also the household boilers and stoves are counted. On the basis of the results of measurements in two sintering plants operating in Poland, the PCB emission factor under the SNAP 030301 sub-category, relevant to conglomerate production processes, has been modified.

Revised national factors for PCB, HCB and PCDD/PCDF emissions

Emission factors obtained by measurements are presented in bold italic. These factors were used for the assessment of the national air emissions of PCB, HCB and PCDD/PCDF in 2000.

Source of PCB emissions	Emission factor adopted [mg/Mg]	Emission factor applied so far [mg/Mg]
03. Combustion in manufacturing industry		
030301 Sinter and palletising plants	***0.065***	2.4
030311 Cement	***0.007***	not available
09. Waste treatment and disposal		
090202 Combustion of industrial waste (modern technology of combustion, good and v. good systems of stack gas cleaning)	***0.38***	not available
090207 Incineration of hospital waste (combustion compliant with the EU Directive)	***0.39***	not available
Source of HCB emissions	**Emission factor adopted [mg/Mg]**	**Emission factor applied so far [mg/Mg]**
03. Combustion processes in industry		
030301 Sintering and palletising plants	***0.14***	4.7
030311 Cement	***0.021***	0.17
09. Waste management		
090202 Combustion of industrial waste (modern technology of combustion, good and v. good systems of stack gas cleaning)	***0.139***	not available
090207 Incineration of hospital waste (combustion compliant with the EU Directive)	***0.295***	not available (the factor applied to all hospital waste was 29)
Source of dioxin and furan emissions	**Emission factor adopted [µg TEQ/Mg]**	**Emission factor applied so far [µg TEQ/Mg]**
03. Combustion processes in industry		
030301 Sintering plants	***1.45***	5
030311 Cement	***0.07***	0.15

Table 4.1. PCB emissions to the air in 2000

Sources of PCB emissions	Activity [Gg]	Emission factor [g/Gg]	Emission [kg]
1	2	3	4
01. Combustion in energy and transformation industries			**120.79**
0101 Public power			
Hard coal	42 006	0.31	13.02
Brown coal	58 754.5	1.8	105.76
Fuel oil	175.2	0.6	0.11
0102 District heating plants			
Hard coal	871	0.31	0.27
Fuel oil	98.4	0.6	0.06
0103 Petroleum refining plants			
Hard coal	8.6	0.31	0.00
Fuel oil	696.8	0.6	0.42
Wood	0.0	0.9	0.00
0104 Solid fuel transformation plants			
Hard coal	120	0.31	0.04
Fuel oil	1.6	0.6	0.00
Wood	0.0	0.9	0.00
0105 Coal mining, oil/gas extraction, pipeline compressors			
Hard coal	1490.2	0.31	0.46
Brown coal	354.1	1.8	0.64
Fuel oil	8.8	0.6	0.01
Wood	0.2	0.9	0.00
02. Non-industrial combustion plants			**356.10**
0201 Commercial and institutional plants			
Hard coal	5723	0.413	2.36
Brown coal	35	1.8	0.06
Fuel oil	30.6	0.6	0.02
Wood	8.1	0.9	0.01
Coke	61.4	3.6	0.22
0202 Residential plants			
Hard coal	8102.8	31.6	256.05
Brown coal	140.5	183.2	25.74
Fuel oil	710.3	3.6	2.56
Wood	6901.0	9	62.11
Coke	410	9.7	3.98
0203 Plants in agriculture, forestry and aquaculture			
Hard coal	1501	0.413	0.62
Brown coal	135.1	1.8	0.24

1	2	3	4
Fuel oil	1109.5	0.6	0.67
Wood	1140.1	0.9	1.03
Coke	120	3.6	0.43
03. Combustion in manufacturing industry			**19.02**
0301 Combustion in boilers, gas turbines and stationary engines			
Hard coal	3078.5	0.31	0.95
Brown coal	5.6	1.8	0.01
Fuel oil	283.1	0.6	0.17
Wood	7.4	0.9	0.01
Coke	6.8	3.6	0.02
0302 Process furnaces without contact			
Hard coal	6484.5	0.31	2.01
Brown coal	41.7	1.8	0.08
Fuel oil	851.8	0.6	0.51
Wood	1739.5	0.9	1.57
Coke	193.7	3.6	0.70
0303 Processes with contact			
Hard coal	3229.9	0.31	1.00
Brown coal	7.4	1.8	0.01
Fuel oil	13.8	0.6	0.01
Wood	1.3	0.9	0.00
Coke	3071.3	3.6	11.06
030301 Sinter and palletising plants	8078.7	0.065	0.53
030309 Secondary copper production	68	2.6	0.18
030310 Secondary aluminium production	46.9	2.6	0.12
030311 Cement*	11 558.5	0.007	0.08
04. Production processes			**80.50**
040203 Pig iron tapping	6491.9	3.6	23.37
040205 Open heart furnace steel plants	414.5	2.6	1.08
040206 Basic oxygen furnace steel plant	6793.8	2.6	17.66
040207 Electric furnace steel plants	3290	2.6	8.55
040208 Rolling mills	11 477.8	2.6	29.84
06. Solvent and other product use			**1 632.00**
060507 Electrical equipment	1.02	1 600 000	1 632.00
07. Road transport			**110.19**
Motor gasoline**	371.4	106	39.37
Unleaded motor gasoline	4559	0.02	0.09
Diesel oil (cars and light duty vehicles)***	16 589 000 000	0.00000005	0.83
Diesel oil (heavy duty vehicles)***	12 969 000 000	0.00000539	69.9

1	2	3	4
09. Waste treatment and disposal			**1.76**
090201 Incineration of domestic or municipal wastes	2.9	0.2	0.00
090202 Incineration of industrial wastes (no APCS)	15.2	30.4	0.46
090202 Incineration of industrial wastes (minimal APCS)	15.6	19.3	0.30
090202 Incineration of industrial wastes (controlled combustion, good or sophisticated APCS)	192.7	0.38	0.07
090207 Incineration of hospital wastes (complying with EU directive)	4.2	0.39	0.00
090207 Incineration of hospital wastes (no or minimal APCS)	46.7	20	0.93
Total			**2320.36**

* The activity is the value of clinker production in Gg; emission factor unit is g/Gg of clinker.

** The calculation was based on literature emission factor 6.32 microgram/km, with mean fuel consumption of 8 litres/100 km and motor gasoline density 0.74 kg/l.

*** The activity is mileage in km; the emission factor unit is g/km.

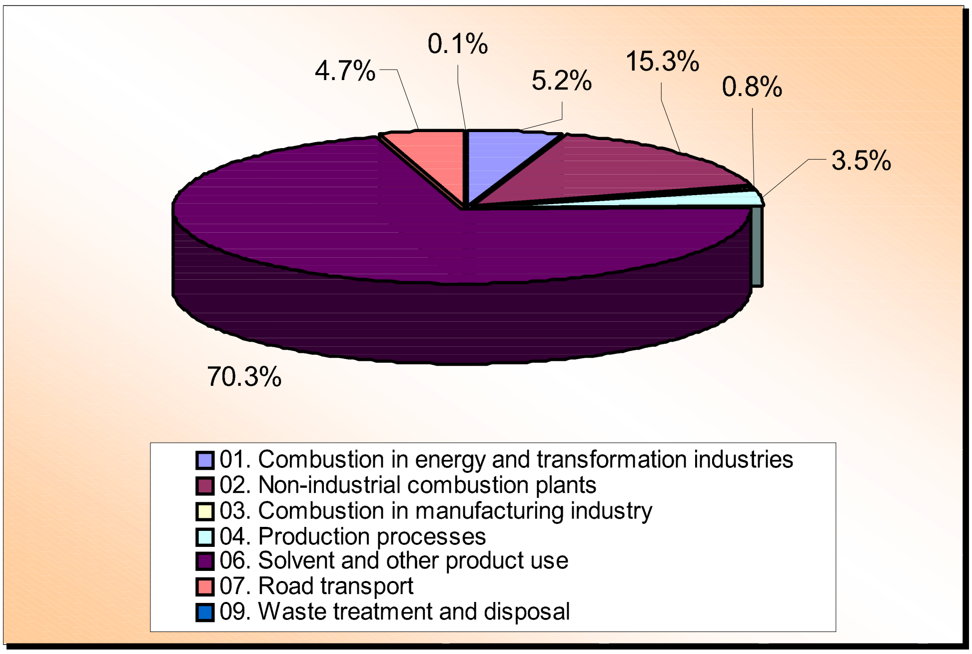


Fig. 4.1. Share of specific sectors in total PCB air emission in 2000

The measurements allowed also calculating the emission factor for the cement factory (SNAP 030311) and for the industrial waste and hospital waste combustion processes in incineration facilities equipped with high efficiency pollution reduction systems. The remaining complementation of sources results from application of factors found in subject literature. This allowed evaluating, among others, emission from road transport (SNAP 07), as well as incineration of industrial, hospital and municipal waste.

4.3. EMISSION OF HEXACHLOROBENZENE

Definitely less publications are available on HCB emissions than on emissions of PCDDs/PCDFs or PCBs. According to the published papers, the main sources of HCB emissions are: application of chlorinated pesticides (polluted with HCB), production of chlorine and chloroorganic compounds (for instance trichloroethylene, tetrachloroethylene, vinyl chloride and carbon tetrachloride), incineration of waste, burning of coal and some metallurgical processes (for instance, certain technologies for production of aluminium or copper alloys, and ore agglomeration).

The emission of HCB into the air in Poland during the year 2000 is estimated at 8.57 kg (Table 4.2). Diagram 4.2 shows the share of specific groups of emission sources in the overall countrywide emission value. The highest 50% share in that emission includes the sources under the category SNAP 03: industrial combustion processes. The highest emission values in this sector are attributed to production of secondary copper (over 30% of country's emission) and to sintering plants (over 13% of the country's HCB emission). Further sources, with significant share in HCB emission, are the waste management (SNAP 09) – 23% of country's emission and combustion processes in the municipal and dwelling sectors (SNAP 02) – 18% of the total country emission. From among sources included in these two SNAP categories, the greatest emission originates from incineration of hospital waste in installations not furnished with air protection equipment or having only the simplest systems reducing air pollution emission (almost 69% of emissions of the entire SNAP 09 category sources) and combustion processes in the residential and services sub-sectors (about 90% of the whole SNAP 02 category sources).

For the assessment of HCB emission values from sintering plants, cement factories as well as hospital and industrial waste incinerators equipped with highly efficient air protection installations, factors based on measurements carried out in Poland were used. Particularly significant was the definition of the country factor from Polish sintering plants because in earlier inventories the many times higher factor from literature was applied. This leads to overestimation of the overall country emission value, in which the HCB emission from sintering processes amounted to

Table 4.2. HCB emissions into the air in 2000

Sources of HCB emissions	Activity [Gg]	Emission factor [g/Gg]	Emission [kg]
1	2	3	4
01. Combustion in energy and transformation industries			**0.58**
0101 Public power			
Hard coal	42 006	0.013	0.55
0102 District heating plants			
Hard coal	871	0.013	0.01
0103 Petroleum refining plants			
Hard coal	8.6	0.013	0.00
0104 Solid fuel transformation plants			
Hard coal	120	0.013	0.00
0105 Coal mining, oil/gas extraction, pipeline compressors			
Hard coal	1490.2	0.013	0.02
Wood	0.2	0.06	0.00
02. Non-industrial combustion plants			**1.58**
0201 Commercial and institutional plants			
Hard coal	5723	0.013	0.07
Wood	8.1	0.06	0.00
0202 Residential plants			
Hard coal	8102.8	0.125	1.01
Wood	6901.0	0.06	0.41
0203 Plants in agriculture, forestry and aquaculture			
Hard coal	1501	0.013	0.02
Wood	1140.1	0.06	0.07
03. Combustion in manufacturing industry			**4.28**
0301 Combustion in boilers, gas turbines and stationary engines			
Hard coal	3078.5	0.013	0.04
Wood	7.4	0.06	0.00
0302 Process furnaces without contact			
Hard coal	6484.5	0.013	0.08
Wood	1739.5	0.06	0.10
0303 Processes with contact			
Hard coal	3229.9	0.013	0.04
Wood	1.3	0.06	0.00
030301 Sinter and palletising plants	8078.7	0.14	1.13
030309 Secondary copper production	68	39	2.65
030311 Cement*	11 558.5	0.021	0.24

1	2	3	4
07. Road transport			**0.16**
Motor gasoline**	371.4	0.355	0.13
Unleaded motor gasoline**	4 559	0.000368	0.00
Diesel oil***	29 558 000 000	8.70E-10	0.03
09. Waste treatment and disposal			**1.97**
090201 Incineration of domestic or municipal wastes	2.9	0.15	0.00
090202 Incineration of industrial wastes (no or minimal APCS)	30.8	19	0.59
090202 Incineration of industrial wastes (good or sophisticated APCS)	192.7	0.139	0.03
090207 Incineration of hospital wastes (complying with EU directive)	4.2	0.295	0.00
090207 Incineration of hospital wastes (no or minimal APCS)	46.7	29	1.35
Total			**8.57**

* The activity is the value of clinker production in Gg; the emission factor unit is g/Gg of clinker.
** Calculation was based on literature emission factor 21 ng/km for motor gasoline and 0.024 ng/km for unleaded motor gasoline, with mean fuel consumption additionally 8 litres and 8.8 litres per 100 km, and density 0.74 kg/l.
*** The activity is mileage in km; the emission factor unit is g/km.

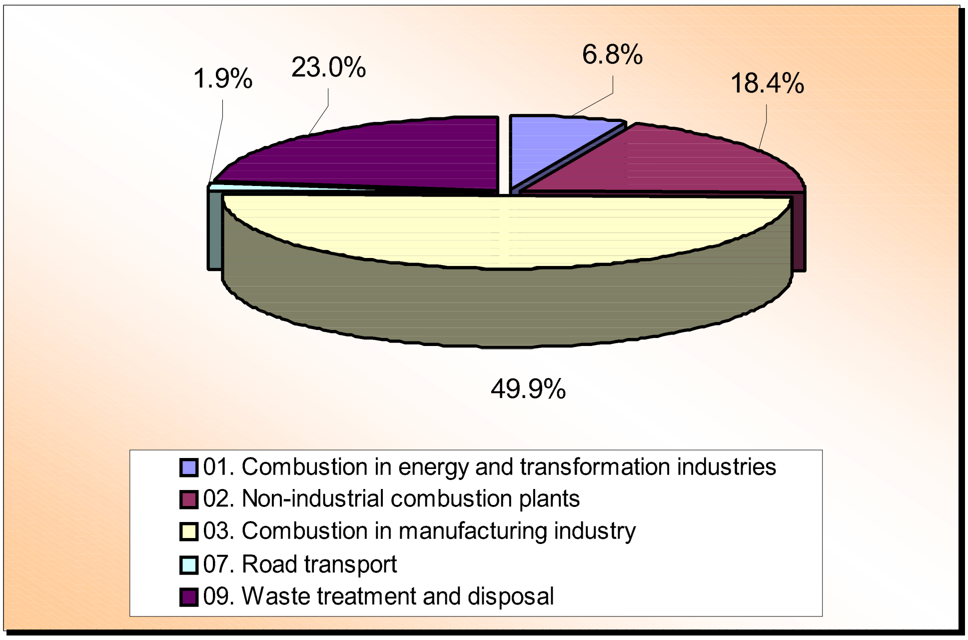


Fig. 4.2. Share of different sectors in the total HCB emission into the air in 2000

82%. The remaining changes and supplementations of emission factors (concerning transport and waste management) are based on published data.

4.4. EMISSION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS

Several series of dioxin emission measurements carried out in the past (1996–2001) allowed to establish the country emission factors for PCDD/PCDF emissions from incineration of hospital waste in facilities of different technologies and differently equipped with air protection systems. Similar measurements enabled also to calculate PCDD/PCDF emission factors from coal combustion in public and industrial power generation plants as well as in households, where waste is burned in stoves or ordinary boilers. Factors of these earlier analyses were already used in inventory activities within the UN ECE and EMEP schemes. In categories lacking local country's factors, the factors selected through reviews of relevant publications, inventory reports and investigations made in other countries were used.

According to studies conducted in the EU countries, 62% of dioxins and furans are emitted into the air. The main sources of PCDD/PCDF emissions in the EU are as follows: controlled incineration of municipal waste – 25.5%, upgrading of metal ores by thermal methods – 17.6%, total burning of timber – 16.4%, incineration of hospital waste – 14.2%, timber conservation – 6.6%, fires – 6.6%, illegal burning of household waste – 3%, processing of recycled raw material – 2%, road transport – 1.9%, steel metallurgy – 1.5%, copper smelting and processing 1.3%, aluminium smelting and processing – 0.7%. The remaining sources of emission are, among others: incineration of industrial waste, coal burning in household fireplaces, industrial coal burning, cement production, smelting and processing of zinc, crematories, non-iron metallurgy and retrieval of metals from cables.

The air emissions of dioxins and furans in Poland in 2000 have been estimated at about 505 TEQ. Detailed information on dioxin and furan emission values from specific sources is given in Table 4.3 and Diagram 4.3. Combustion processes in the municipal and household sector (SNAP 02), responsible for about 37% of the total country's PCDD/PCDF emission, are recognised as the main source of that pollution. Within that SNAP category, emission from the dwelling and services subcategory (SNAP 0202) dominates, involving, among others, burning processes in household fireplaces (SNAP 020205), where often household waste is being burned with the usual fuel. Emission from the SNAP 0202 subcategory amounts to more than 98% of emission of municipal and dwelling sector, hence over 36% of the total country's emission. Emission from the waste management sector (about 30% of the country's emission) constitutes the second largest source of dioxins. Within this sector's emission, the incineration of industrial (including hazardous waste) and hospital wastes in facilities without stack gases cleaning equipment, presents the largest share of releases. Emission of PCDDs/PCDFs into the air from hazardous and industrial wastes incinerated without any air protection equipment amounts to about 50% and 30% respectively of the entire SNAP 09 category. The share of such emission from hospital waste, treated under the same conditions amounts to 7%. Similarly almost 7% share of the emission in the SNAP 09 category from field burning of agricultural (post harvest) waste is regarded as significant. It must be mentioned that the emission estimates for the SNAP 09 category, concerning the amounts of industrial waste production, thus, information on their thermal treatment, were based on GUS publications. Since public statistics comprise only the larger waste producers, the values obtained seem to be underestimated and the emission values burdened with great uncertainty. In the national inventory of dioxins and furans carried out in accordance with UNEP Chemicals method the actual value of PCDD/PCDF emission has been estimated for the year 2000 between 1 and 81 g TEQ for hazardous waste and 5.23 and 123 g TEQ for other industrial waste.

The quantity of hospital waste was calculated from the number of beds in public and private hospitals and the data on their occupation by patients, considering that 1.6 kg of waste is generated in average from one occupied hospital bed daily. It is difficult to determine the quantities of industrial and hospital waste incinerated by particular types of incinerators. A subdivision was made basing on professional expertise and estimated data prepared, among others, for the purpose of elaborating the implementation plan of the EU Directive 94/67/EC, concerning incineration of hazardous waste.

The next significant sources of dioxin and furan emission are fires of waste landfills, buildings (both residential and industrial) and motor vehicles. These sources, along with forest fires and cigarette smoking, have been classified into category: other sources of emission and absorption of emissions – SNAP 11 (in some studies these sources are distinguished into a separate, twelfth category). In the year 2000 the emission from sources classified into the SNAP 11 amounted to 13% of the country's emission, of which over 73% (almost 10% of country's emission) originates from emissions of burning waste landfills. The volume of emission from landfills is largely uncertain, for it is very difficult to establish accurately the mass of waste burned in landfill fires accurately, and the number of such fires is also an estimated value. Application of factors from literature allows only for a rough determination of the emission value, because such factors directly depend on the density of waste – hence, on the degree of the compression – a parameter strongly differentiated, depending on the method of a particular landfill management. In addition, the mass of plant residues on cropland is an estimated value. It was calculated from the area of cultivated farmland (according to GUS in 2000 it was 14129.3 thousand hectares) and the EMEP/CORINAIR emission factor, determining the amount of biomass burned per one hectare of cultivated area at the level of 0.025 tonnes.

The amount of timber burned in Poland is presented in volume units and in energy units. This requires recalculation of these data into the units of mass. According to information of the Central Statistical Office the average fuel value of wood amounts to 9.5 GJ/m^3 and the weight to volume factor varies between 11.9 to 19 TJ/Gg. For the purpose of inventory a mean value of 15 TJ/Gg was adopted.

Significant supplementations and verifications of some of the factors concerning inventory of dioxin emissions were made. New sources of emissions, not considered in the earlier country's evaluations (report for the UN ECE/EMEP covering the year 2000), were added, mainly because of lack of such factors. The values of factors in categories for which emission was formerly not evaluated were taken from the "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases" [UNEP Chemicals 2001]. Most significant for the estimated value of PCDD/PCDF emission was the acceptance of factors of the SNAP 090202 subcategory (i.e. incineration of industrial and hazardous waste, the emission of which presents more than 25% of the countrywide emission) and additionally factors of the SNAP 1125 category (about 13% of countrywide emission), under which, among others, the emission from fires of landfills, houses, factories and motor vehicles are included. Information on emission from industrial processes, i.e. production of lime, glass, smoked food products, smelting of non-iron metals (zinc, lead, and aluminium) and agriculture has been significantly completed. Some of the used factors were also verified. Factors of the SNAP 0203 subcategory have been reduced after it was concluded, that the vast majority of installations included in that sector are much closer to those operating in industrial and public power stations than to those functioning within the residential and services sub-sector, particularly to household fireplaces. On the basis of measurements carried out by the team of the Kraków Technical University, also the factors of emissions from sintering plants, cement factories and incineration of hospital waste in incinerators equipped with air protection systems of medium efficiency, have been reduced. In all these instances factors were reduced in comparison with those previously applied.

Table 4.3. PCDD/PCDF emissions to the air in 2000

Sources of dioxin and furan emission	Activity [Gg]	Emission Factor [mg TEQ/Gg]	Emission [mg TEQ]
1	2	3	4
01. Combustion in energy and transformation industries			**7197.3**
0101 Public power			
Hard coal	42 006	0.06	2520.4
Brown coal	58 754.5	0.06	3525.3
Fuel oil	175.2	1	175.2
0102 District heating plants			
Hard coal	871	0.06	52.3
Brown coal	0.0	0.06	0.0
Fuel oil	98.4	1	98.4
0103 Petroleum refining plants			
Hard coal	8.6	0.06	0.5
Brown coal	0.0	0.06	0.0
Fuel oil	696.8	1	696.8
Wood	0.0	1	0.0
0104 Solid fuel transformation plants			
Hard coal	120	0.06	7.2
Brown coal	0.0	0.06	0.0
Fuel oil	1.6	1	1.6
Wood	0.0	1	0.0
0105 Coal mining, oil/gas extraction, pipeline compressors			
Hard coal	1490.2	0.06	89.4
Brown coal	354.1	0.06	21.2
Fuel oil	8.8	1	8.8
Wood	0.2	1	0.2
02. Non-industrial combustion plants			185 202.7
0201 Commercial and institutional plants			
Hard coal	5723	0.06	343.4
Brown coal	35	0.06	2.1
Fuel oil	30.6	1	30.6
Wood	8.1	1	8.1
0202 Residential plants			
Hard coal	8102.8	18	145 850.4
Brown coal	140.5	10	1405.0
Fuel oil	710.3	1	710.3
Wood	6901.0	5	34 505.0
0203 Plants in agriculture, forestry and aquaculture			
Hard coal	1501	0.06	90.1

1	2	3	4
Brown coal	135.1	0.06	8.1
Fuel oil	1109.5	1	1109.5
Wood	1140.1	1	1140.1
03. Combustion in manufacturing industry			52 607.3
0301 Combustion in boilers, gas turbines and stationary engines			
Hard coal	3078.5	0.06	184.7
Brown coal	5.6	0.06	0.3
Fuel oil	283.1	1	283.1
Wood	7.4	1	7.4
0302 Process furnaces without contact			
Hard coal	6484.5	0.06	389.1
Brown coal	41.7	0.06	2.5
Fuel oil	851.8	1	851.8
Wood	1739.5	1	1739.5
0303 Processes with contact			
Hard coal	3229.9	0.06	193.8
Brown coal	7.4	0.06	0.4
Fuel oil	13.8	1	13.8
Wood	1.3	1	1.3
030301 Sinter and palletising plants	8078.7	1.45	11 714.1
030307 Secondary lead production	36.8	8	294.4
030308 Secondary zinc production (minimal APCS)	15.2	100	1520.0
030308 Secondary zinc production (casting and remelting only)	9.6	0.3	2.9
030309 Secondary copper production	68	50	3400.0
030310 Secondary aluminium production (scrap processing)	123.2	150	18 480.0
030310 Secondary aluminium production (casting of alloys)	75	1.3	97.5
030311 Cement*	11 558.5	0.07	809.1
030312 Lime (no or minimal APCS)	1188	10	11 880.0
030312 Lime (good APCS)	1188	0.07	83.2
030313 Asphalt concrete plants (no APCS)	520.8	0.07	36.5
030313 Asphalt concrete plants (fabric filters)	520.8	0.007	3.6
030314-17 Glass (no or minimal APCS)	1549.6	0.2	309.9
030319 Bricks and tiles (no or minimal APCS)	1040	0.2	208.0
030319 Bricks and tiles (good APCS)	1460	0.02	29.2
030320 Fine ceramic materials (no or minimal APCS)	323.5	0.2	64.7
030320 Fine ceramic materials (good APCS)	323.5	0.02	6.5
04. Production processes			**38 444.5**
040201 Coke oven (dust removal/ afterburner)	9069.4	0.3	2720.8

1	2	3	4
040203 Pig iron tapping	6491.9	2	12 983.8
040205 Open heart furnace steel plants	414.5	2	829.0
040207 Electric furnace steel plants	3290	2	6580.0
040301 Aluminium production	46.9	2	93.8
040617 Other (smoke houses - clean fuel, no afterburner)	229.1	6	1374.6
040617 Other (smoke houses - clean fuel, afterburner)	458.2	0.6	274.9
07. Road transport			**1452.3**
Motor gasoline	371.4	2.2	817.1
Unleaded motor gasoline	4559.5	0.104	474.2
Diesel oil	3745	0.043	161.0
08. Other mobile sources and machinery			**211.1**
Motor gasoline	68.1	2.2	149.8
Diesel oil	1426	0.043	61.3
09. Waste treatment and disposal			**152 476.3**
090201 Incineration of domestic or municipal wastes (sophisticated APCS)	2.9	0.5	1.5
090202 Incineration of industrial wastes (no APCS)	13	3500	45 500.0
090202 Incineration of industrial wastes (minimal APCS)	13	350	4550.0
090202 Incineration of industrial wastes (good APCS)	84	30	2520.0
090202 Incineration of industrial wastes (sophisticated APCS)	53.5	0.5	26.8
090202 Incineration of industrial wastes - dangerous wastes (no APCS)	2.16	35000	75 600.0
090202 Incineration of industrial wastes - dangerous wastes (minimal APCS)	2.64	350	924.0
090202 Incineration of industrial wastes - dangerous wastes (good APCS)	40.8	10	408.0
090202 Incineration of industrial wastes - dangerous wastes (sophisticated APCS)	14.4	0.75	10.8
090205 Incineration of sludge from waste water treatment (with APCS)	5.9	4	23.6
090207 Incineration of hospital wastes (complying with EU directive)	4.2	1.4	5.9
090207 Incineration of hospital wastes (minimal or good APCS)	22.9	68	1557.2
090207 Incineration of hospital wastes (no APCS)	23.8	453.3	10 788.5
0907 Open burning of agricultural wastes (except 1003)	350	30	10 500.0
090901 Cremations**	6000	0.01	60.0

1	2	3	4
10. Agriculture			**521.0**
1003 On-field burning of stubble, straw	16.8	5	84.0
1003 On-field burning of stubble, straw (unmanaged fields' fires)	87.4	5	437.0
11. Other sources and sinks			**67 168.6**
1103 Forest fires	260	5	1300.0
1125 Other (landfill fires)	49.3	1000	49 300.0
1125 Other (vehicle fires)	38.3	94	3600.2
1125 Other (houses and factories fires)	32.4	400	12 960.0
1125 Other (cigarette smoking)***	83.8 billion	1.00E-10	8.4
Total			**505 281.1**

* The activity is the amount of clinker production in Gg the emission factor unit is mg TEQ/Gg of clinker.
** The activity is number of cremated bodies; the emission factor unit is mg TEQ/body.
*** The activity is number of cigarettes; the emission factor unit is mg TEQ/cigarette.

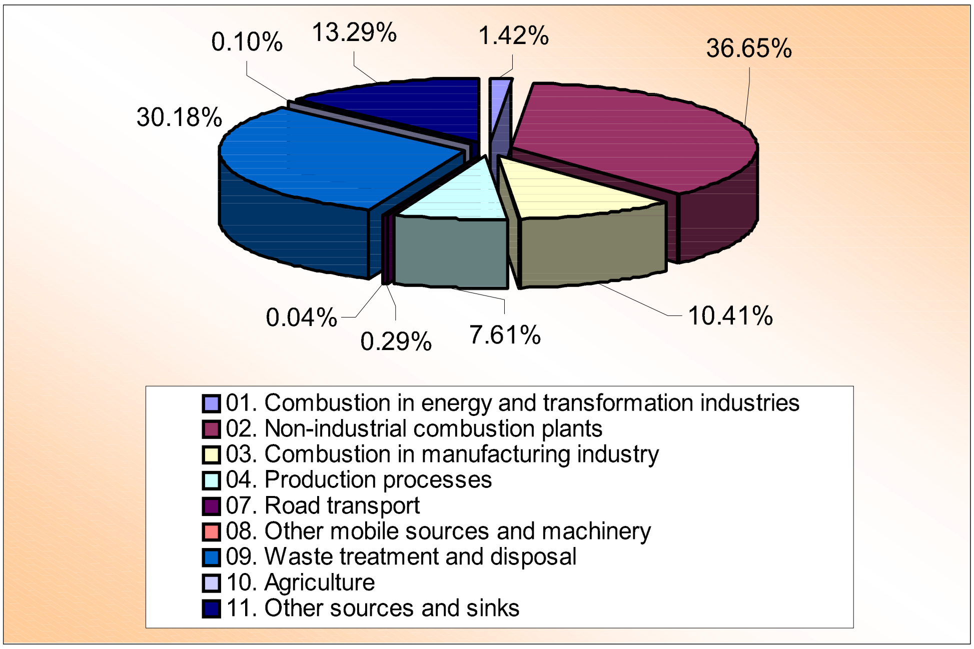


Fig. 4.3. Share of individual sectors in PCDD/PCDF air emission in 2000

5. POLLUTION OF SURFACE WATERS AND POP RELEASES WITH WASTE, PRODUCTS AND DIRECTLY INTO THE GROUND

5.1. INTRODUCTORY INFORMATION

Assessment of POP releases into water, soil, waste/residues and products is more difficult and definitely less complex in comparison with the assessment of air emission, because of the very limited information on emission factors into these media. The assessment of PCDD releases into these media was performed on the basis of factors published by UNEP Chemicals and is presented in Chapters 5.1 and 5.2. It must be stressed that the values of emission factors are not known for many categories, and despite of the conviction that such emission takes place, it could not be considered in the process of evaluation. Therefore, the emission values are presumably underestimated. With reference to releases of HCB and PCBs into water, soil, waste/residues and products only the potential sources of these pollutants are indicated.

5.2. RELEASES WITH WASTEWATER

Releases of POPs with wastewater, and PCDDs/PCDFs, HCB and PCBs in particular, belong to the least recognised elements threatening the environment. Lack of regulatory requirements to measure the level of POPs in wastewater in Poland, and to charge for POPs discharged is to be blamed for that situation.

During 1999–2002, in connection with the EU approximation process, an attempt was made to establish by the method of inquiry, which production processes and which industries may discharge hazardous substances subject of the EU Directive 76/464/EEC and its daughter directives, including substances controlled by the Stockholm Convention, into sewer networks. Two hundred and fifty enterprises have been covered by the enquiry. Basing on its results a conclusion could be drawn, that at least 1000 large and medium enterprises exist, which potentially may discharge POPs with their wastewater. However, the quantity of such discharge could not be defined. Having the above in mind, pilot tests of POPs concentration in wastewater from about 1000 industrial enterprises were included into the Implementation Plan of the EU Directive 76/464/EEC and are expected to be carried out in 2004. For the time being the assessment of POPs releases with wastewater is possible only by using factors published by UNEP Chemicals, relevant to specific types of production processes. Such assessment was performed just for PCDDs/PCDFs with the following outcome (Table 5.1).

Data presented in Table 5.1 do not include all categories of sources of dioxin and furan release into water, therefore two following conclusions can be drawn:

Table 5.1. Releases of PCDDs/PCDFs into waters during the year 2000

Sources of dioxin/furan release	Activity [Gg]	Emission factor [mg TEQ/Gg]	Emission [mg TEQ]
04. Production processes			**94.1**
040201 Coke production (after-burning, dust filters)	9069.4	0.006	54.4
040508 Polyvinyl chloride production (PVC)	273.9	0.03	8.2
0406 Processes in timber, paper and other industries (Kraft process, chlorine-less bleaching)	300.4	0.06	18.0
0406 Processes in timber, paper and other industries (unbleached paper pulp)	450.5	0.03	13.5
09. Waste management			**1122.9**
091002 Wastewater treatment in the municipal sector (without sludge disposal)*	250 578	0.002	501.2
091002 Wastewater treatment in the municipal sector (with sludge disposal)**	792 947	0.0005	396.5
091002 Wastewater treatment in the municipal sector (treatment on bio-filter)*	450 475	0.0005	225.2
Total			**1217.0**

* Activity in Gg of wastewater, emission index in mg TEQ per Gg of wastewater.

(1) the main sources of dioxin and furan releases into water are not industrial production processes but wastewater treatment processes (in Table 5.1 – 92%),
(2) releases of dioxins and furans with wastewater are for many times lower than the emission into the air (compare data under Chapter 4). The Technical Report GF/POL/ /INV/R.13, prepared in the course of the Priority Setting Phase of the GF/POL/01/004 Project (see list in Annex 5A), quotes published factors of PCDD/PCDF releases into water for 30 activity categories according to SNAP. After additional review of these categories, the inventory table concerning PCDD/PCDF releases into waters in the year 2000 (Table 5.1) will possibly be considerably extended.

No sufficient data could be gathered to assess the total release of PCBs and HCB into waters. An assumption could only be made that the releases from wastewater treatment processes could be estimated for over 50% and from industrial processes below 15% of all releases.

5.3. ENVIRONMENTAL RELEASES OF POPs WITH WASTES, RESIDUES AND INDUSTRIAL PRODUCTS

5.3.1. Wastes and residues

Similarly, as in the case of wastewater, no direct measurements of PCDD/PCDF, HCB and PCB concentrations in wastes, disposed of into the environment (except for PCB content in the used and discarded electro-technical equipment) are available. Under these circumstances, only the factors published in technical periodicals can be used to evaluate the amount of POPs released with wastes, residues and industrial products. Such evaluation was carried out for the year 2000 as a task within the framework of inventories performed by this project (see Annex 5A). Forty categories of emission sources, according to the SNAP classification, were considered. Summary results have been put together in Table 5.2.

The volume of dioxin and furan releases with waste to the environment (341.3g/year) is comparable with the volume of such releases into the air (505.3 g/year). Likewise the releases with wastewater, the data available are not sufficient for the assessment of PCB and HCB environmental releases with wastes disposed of. It can merely be stated that their main source are the electric steelworks and secondary aluminium processing and minor releases come from: coal combustion, secondary copper processing, basic oxygen furnace shops, incineration of industrial waste and municipal wastewater treatment.

Table 5.2. Releases of PCDDs/PCDFs into waste/residues in the year 2000

Sources of dioxin and furan releases	Release [g TEQ]	% total of releases
01 Combustion processes in energy production and transformation	13.3	4
02 Combustion processes in municipal and dwelling sectors	31.1	9
03 Combustion processes in industrial sector	98.0	29
04 Production processes	59.7	18
05 Waste management (mainly wastewater treatment and incineration of sludge)	139.2	40
Total	**341.3**	**100**

5.3.2. Products

Persistent organic pollutants can be released into the environment together with industrial products and other types of economic activities. Such releases may take place either during the use of products mentioned above or after they are discarded as waste. Again, like in the case of wastewater and wastes, no sufficient and reliable data on the content of POPs in certain products and the degree of their environmental releases are available. Estimates of these releases, based on emission factors found in technical literature, indicate that this type of releases is not significant in comparison with releases into the air and through wastes (Tables 5.3 and 5.4).

Data presented in Tables 5.3 and 5.4 indicate that the environmental releases of dioxins and furans by the route of products are not significant in comparison with the releases into the air and with wastes. Their main sources are paper and chemical industries.

There are no sufficient data available to assess the quantitative releases of PCBs and HCB with products. It may be only estimated that more than 50% of releases of

Table 5.3. PCDD/PCDF releases into products in the year 2000

Sources of dioxin and furan releases	Activity [Gg]	Emission factor [mg TEQ/Gg]	Emission [mg TEQ]
04. Production processes			10 684.2
040508 Polyvinyl chloride production (PVC)	273.9	0.1	27.4
040525 Production of pesticides (2.4-D; 2.4-bichlorophenoxyacetic acid)	4	700	2800.0
0406 Processes in timber. paper and other industries (biomass drying –pure timber)	1353.1	0.1	135.3
0406 Processes in timber. paper and other industries (Kraft process. chlorine-less bleaching)	1223.0	0.5	611.5
0406 Processes in timber. paper and other industries (recycled paper)	711	10	7110.0
06. Application of solvents and other products			63.8
060312 Fabrics finishing	63.8	1	63.8
09. Waste management			32.2
091005 Production of compost	322	0.1	32.2
Total			**10 780.2**

Table 5.4. Share of particular sectors in the release of PCDD/PCDF to the environment as pollution of the manufactured produce in the year 2000

Sources of dioxin and furan releases	Release [g TEQ]	% of total release
04 Production processes (production of PVC, pesticides, paper and timber articles)	10.7	99.0
06 Application of solvents (finishing fabrics)	0.06	0.6
09 Waste management (compost production)	0.03	0.4
Total	**10.8**	**100**

such substances originate from secondary paper production, more than 15% from pesticide production and less than 15% from the remaining processes in the paper and timber industries, PVC production, pesticides, compost and fabric finishing.

5.3.3. Releases directly into the soil

Dioxins and furans are released directly into the soil in result of burning agricultural waste, directly on the earth surface (burning dry grass, stubble-fields and straw) and in result of forest fires. Preliminary inventory of these releases indicates that it is not a significant source of dioxin and furan emissions to the environment (Table 5.5) in comparison with the emission into the air and with wastes.

Table 5.5. PCDD/PCDF releases directly into the soil in 2000

Sources of dioxins and furans release	Activity [Gg]	Emission factor [mg TEQ/Gg]	Emission [mg TEQ]
09. Waste management			3500.0
0907 Open burning of agricultural waste (without 1003)	350	10	3500.0
10. Agriculture			416.8
1003 Burning stubble-fields and straw	16.8	4	67.2
1003 Burning stubble-fields and straw (idle land fires)	87.4	4	349.6
11. Other sources of emission and absorption of pollutions			1040.0
1103 Forest fires	260	4	1040.0
Total			**4956.8**

Published data, based mainly on British inventories, indicate cutting and fragmentation of scrap-iron (70–90%), leakages from capacitors (5–15%), land filling of municipal waste (1–5%), leakages from transformers (0.5–2%), agricultural use of wastewater (1–3%) as the main sources of release of PCBs into the soil. The share of remaining sources does not exceed 0.5% of total releases. Lack of credible data on factors concerning emission into the soil and on the number of electro-technical appliances (transformers, capacitors and electric cables) disposed of on scrap heaps did not allow for making an estimate of direct release of PCBs into the soil.

Even less evidence in this respect can be found in relation to HCB. Presumably some industrial waste landfills, pesticide landfills, deposits from air and rainwater drained by leaking sewers may be the sources of HCB release.

Table 5.6. Share of specific sectors in PCDD/PCDF relases directly into the soil in 2000

Sources of dioxin and furan releases	Release [g TEQ]	% of total release
9. Waste management	3.50	71
10. Agriculture (burning grass, stubbles and straw)	0.42	8
11. Other sources (forest fires)	1.04	21
Total	**4.96**	**100**

5.3.4. Releases into specific environmental media

Assessment of dioxin and furan emissions into the air (see Chapter 4) and to waters (see section 5.1) as well as with wastes, residues, products and directly into the soil allows estimating roughly the shares of releases into specific environmental media. Results of such an estimate indicate that 58% of the total dioxin and furan emission goes into the air; almost 40% of the total release of dioxins and furans comes from wastes and the remaining share (2%) from water[11], products and directly into the soil (Table 5.7 and Diagram 5.1).

As far as PCBs and HCB are concerned, the available information on release of these substances is not sufficient enough to calculate the respective quantities of pollutants penetrating into wastewater, wastes, residues and products. It was only possible to indicate from which processes the penetration of PCBs and HCB into wastewater, wastes/residues, products and soil can be expected.

[11] The share of wastewater in the total environmental emission of dioxins and furans is underestimated because of lack of reliable emission factors. The structure of PCDD/PCDF flows into specific environmental media may change after the emission with wastewater is verified.

Table 5.7. PCDD/PCDF emission/release into specific environmental media in 2000

Particulars	Air	Water	Wastes and residues	Products	Soil
Emission/release of dioxins and furans [g TEQ]	505.3	1.22	341.3	10.8	5.0
Share in %	58.5	0.1	39.5	1.3	0.6

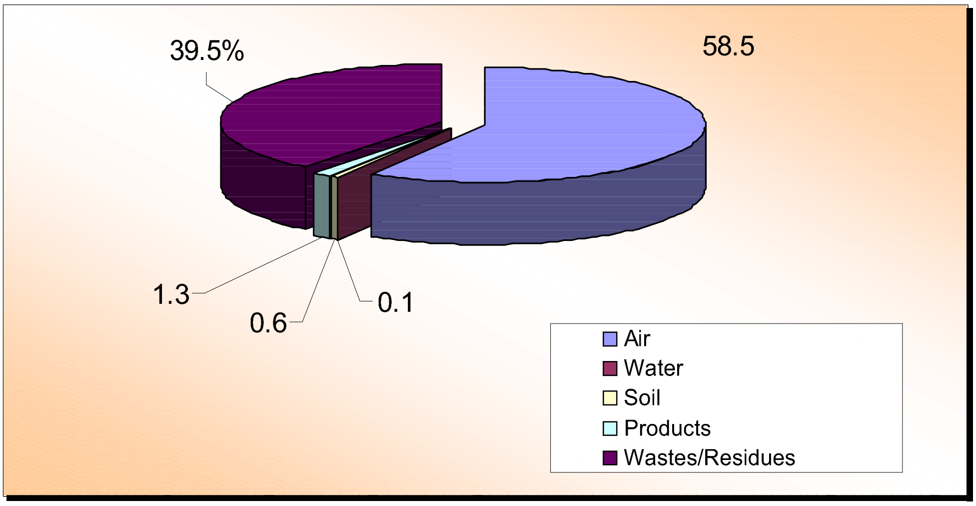


Fig. 5.1. Release of dioxins and furans into specific environmental media in the year 2000

It would be right to assume that PCBs and HCB are released into wastewater, wastes/residues, products and soil from processes being also sources of PCDD/PCDF release. However, no adequate emission factors for PCBs and HCB, similarly comprehensive and credibly confirmed by research as for PCDDs/PCDFs, exist. Therefore, any quantitative estimates are either impossible or highly uncertain.

5.4. PERSISTENT ORGANIC POLLUTANTS IN RIVERS

5.4.1. Historical data

Studies on threats from surface water pollution by insecticides of the chlorinated hydrocarbons were carried out in Poland for the first time in 1964 by the Institute of Water Management in Warsaw (now the Institute of Meteorology and Water Management) at the Division of Coastal Drainage Water Protection in Gdańsk. It was concluded that, from among pesticides applied during 1961–1964, the following were most dangerous for fish (from more to less hazardous): DDT > toxaphene > > metoxychlor[12] (DMDT) > lindane[12] (γ-HCH). Such hierarchy was primarily the effect of large use of DDT in relation to the remaining substances (3.2 thousand tonnes in 1961 and 1.1 thousand tonnes in 1964).

Aldrin was used in very small quantities (10–20 tonnes/year) and only until 1962. The remaining pesticides, covered by the Stockholm Convention, were not applied in Poland at that time.

The first tests on the presence of polychlorinated insecticides in surface waters were performed in the same research centre in 1968–1972 along the Vistula River mouth. During 1968–1969 the MPCA and lindane were scattered from appliances situated at the ground, and toxaphene from airplanes. After 1969 this was done only from the ground. Concentrations of these substances, just after spraying, remained very high in drainage canals for several hours.

- DDT – 125 μg/l,
- γ-HCH – 100 μg/l,
- DMDT – 15 μg/l,
- toxaphene – 100 μg/l.

Within the following two months these concentrations usually fell down below 20 μg/l, and after a longer period stabilized at the following level:

DDT and DMDT – 3.0 μg/l and γ-HCH – 0.6 μg/l.

In the following years 1972–1975, the studies were undertaken on POPs concentrations in the Vistula River in the vicinity of Kraków, Warsaw and Gdańsk. The average concentrations of the tested pesticides in 1975 are presented in the Table 5.8.

During 1980–1989 the concentrations of the tested POPs in surface waters were further falling, however, they still remained at quite a high level in river basins under intensive farming and in waters heavily polluted by wastewaters (Table 5.9.)

It has to be added that momentary concentrations (maximum measured) in surface waters, polluted by wastewater, reached the level of several mg/l: for DDT – 7.9; for DDE – 1.3; for DDD – 1.8; for γ-HCH – 6.0; for DMDT – 1.0.

A general statement can be formulated that during the historical period (1961–1990) the concentrations of pesticides in surface waters, not being a subject of strong pressure of industrial wastewater discharge or intensive farming, did not exceed the safe levels.

Concentrations of DDT and DMDT exceeded the safe levels in waters heavy polluted with industrial wastewater, in respect of lindane, and also in surface waters within areas of intensive farming.

[12] It is not included in the Stockholm Convention.

Table 5.8. Average concentrations of polychlorinated insecticides at selected cross-sections of the Vistula River in 1975 [μg/l]

Polluting substances	Upper Vistula (Kraków)	Mid Vistula (Warsaw)	Vistula River Mouth (Gdańsk)
Σ DDT	1.33	0.09	0.040
γ-HCH	0.67	0.15	0.100
DMDT	0.66	0.01	0.002

Table 5.9. Average concentrations of polychlorinated insecticides in surface waters during 1980–1989 [μg/l]

Polluting substance	Waters in basins with intensive farming	Waters heavily polluted by wastewaters	Surface waters (average)	Safe concentrations according to:		
				Polish standards	EU Directives	US standards
DDT	0.039	0.264	0.005	0.05		0.03
DDE (DDT metabolite)	0.016	0.064	–	0.05	<0.001	
DDD (DDT metabolite)	0.002	0.050	–	0.05		0.01
Lindane (γ-HCH)	0.178	0.207	0.005	0.05	<0.08	
Metoxychlor (DMDT)	0.001	0.049	0.005	0.05		0.02

– data not avaiable.

5.4.2. Present situation. River waters

Systematic investigations of river water pollution by chloroorganic substances are presently conducted on 20 river cross sections (5 on the Vistula River, 5 on the Oder River and 10 on rivers of the coastal drainage belt area) and only in respect of 2 groups of substances controlled by the Stockholm Convention: DDT with its metabolites DDE, DDD, and PCBs. These are the tests performed within the system of the State Environmental Monitoring co-ordinated by the Chief Inspectorate for Environmental Protection. Generalized results are presented in Table 5.10.

Concentrations of remaining substances, covered by the Stockholm Convention, were tested in Polish rivers sporadically during the last decade (Table 5.11).

Table 5.10. Average annual concentrations of the sum of DDT and PCBs during the period of 1992–2001 [μg/l]

Year	Substances	Vistula River			Oder River		
		Krakow	Warsaw	Kiezmark	Chałupki	Krakow	Warsaw
1992	Σ DDT	0.032	0.070	0.016	0.012	0.003	0.024
	PCB	0.027	0.008	0.008	0.002	0.001	<0.001*
1995	Σ DDT	0.047	0.027	<0.001*	0.012	0.018	0.012
	PCB	0.013	0.009	0.001	0.017	0.097	<0.001*
2000	Σ DDT	0.051	0.086	<0.001*	0.005	0.016	0.011
	PCB	0.017	0.014	<0.001*	0.001	0.016	<0.001*
2001	Σ DDT	0.022	0.044	<0.001*	0.003	0.004	0.008
	PCB	0.008	0.008	<0.001*	0.010	0.016	<0.001*
Average for 1992–2001	Σ DDT	0.063	0.048	0.020	0.013	0.028	0.014
	PCB	0.015	0.011	0.009	0.007	0.010	<0.001*

* Below the threshold of detectability 0.001 μg/l.

Table 5.11. Concentrations of selected POPs in surface waters of Poland [ng/l]

Measurement location	Year	Endrin	Chlordane	Heptachlor	HCB	ΣDDT	ΣPCB
Vistula Mouth (Kiezmark)	1991– –1992	–	0.004– –0.019	0.0021– –0.020	0.0076– –0.05	0.120– –0.840	0.120– –0.300
Mała Panew River	1999	69	–	–	–	186	–
Radunia River	1984– –1988	–	–	–	–	n.d.–139	–
Oder (Police)	1999	–	–	–	–	8	–
Oder River Basin	1998– –2000	–	–	–	–	0.8–218	0.3–150

– lack of data.
n.d. – not detected.

5.4.3. Present situation. River bottom sediments

Extensive studies on POPs in bottom sediments of the Oder River and its tributaries were conducted during 1998–2000, within the framework of the “International Oder Project” implemented after the tragic floods in 1997. Generalized results of these studies are put together in Tables 5.12 and 5.13.

Table 5.12. Content of chloroorganic pesticides in the Oder River and its tributaries' bottom sediments in the period of 1998–2000

Pesticides	Minimum–Maximum [ng/g dry matter]	Average value [ng/g dry matter]
DDE	1 – 27.8	5.2
DDD	1 – 27.6	4.2
DDT	1 – 31.2	3.2
Σ DDT	1 – 51.7	12.6
α-HCH	1 – 42.8	2.2
γ-HCH	1 – 177.0	21.1
δ-HCH	1 – 42.1	4.7
DMDT	1 – 14.9	2.0
Total of pesticides tested	**1.1 – 208.7**	**40.7**

Table 5.13. PCB content in the Oder River and its tributaries bottom sediments in 1998–2000

PCB Congener	Minimum–Maximum [ng/g d.m.]	Average value [ng/g d.m.]
52	1 – 23.3	2.2
101	1 – 9.1	2.3
118	1 – 30.5	4.0
153	1 – 19.3	3.8
138	1 – 23.1	4.6
180	1 – 46.9	6.4
189	1 – 1.0	0.4
Total of PCBs determined	**1.3 – 189**	**28.9**

The average value of DDT exceeds the permissible concentration for protected areas (2.5 ng/g dry matter) but is by half lower than the permitted content for areas under farming and forests, or appropriated as residential, recreation and waste land areas (25 ng/g dry matter) and 20 times lower than the permissible standard for industrial and transport areas (250 ng/g dry matter). In addition, the maximum value does not exceed the standard of 250 ng/g dry matter.

The above mentioned permissible values are drawn from the Regulation of the Minister of the Environment[13] of 9 September 2002.

The said Regulation establishes permissible content of 7 PCBs total at 2000 ng/g d.m. for industrial and transport areas and 20 ng/g d.m. for the remaining areas. The average values for PCB content in bottom sediments of the Oder River exceed the permissible values for protected areas, agricultural land and forests as well as residential and recreation areas and wasteland.

In terms of POP concentration in bottom sediments the Włocławek Reservoir situated on the 675 km of the Vistula River is particularly interesting. It retains pollution transported from Upper Silesia, Krakow, Warsaw urban agglomeration up to Płock as bottom sediments. The drainage basin covers about 170 000 km^2 presenting 45% of the country's territory.

Detailed investigations of some chloroorganic substances in bottom sediments were carried out in the Włocławek Reservoir by the State Geological Institute in the year 2000. Within the framework of the GF/POL/01/004 project additional measurements and investigations aimed to define the concentration of the remaining POPs, i.e. coplanar PCBs, dioxins and furans. Results are summarised in Table 5.14.

Comparison of average values for DDT, aldrin, dieldrin, endrin and PCBs, included in Tables 5.14 with the values presented by the Regulation of the Minister of the

Table 5.14. Content of substances subject to the Stockholm Convention in bottom sediments of the Włocławek Reservoir

Substances	Content [ng/g d.m.]	Source
Aldrin	0.322*	Data of the State Geological Institute
Dieldrin	0.042*	
Endrin	0.543*	
Heptachlor	2.795*	
DDT	1.692*	
PCB (28,52,101,118,153,138,180)	1.258*	
PCB (77,126,169)	0.164	Data of the GF/POL/01/004 Project
Dioxins	1.154	
Furans	0.077	

* Average value.

[13] Regulation of the Minister of the Environment of 9 September 2002 on soil quality standards and ground quality standards (Dz.U. No. 165, item 1359).

Environment[13] indicates that for agricultural and forest land as well as for residential and recreation areas (the latter dominate in that region), the permissible levels in the bottom sediments of the Włocławek Reservoir have not been exceeded.

Most of PCB congeners, dioxins and furans, defined by the WHO as most toxic, including dioxins – 2,3,7,8-TCDD were detected in bottom sediments of the Włocławek Reservoir. The level of toxicity of sediments analysed determined by the value of TEQ, was higher than in sediments from Oder and Vistula Rivers outlets.

5.5. DISCHARGES OF POPs INTO THE BALTIC SEA

As reported by GUS – the Central Statistical Office ("Environmental Protection 2000"), DDT and DMDT pollution loads discharged from the Polish territory into the Baltic Sea were systematically falling down in the years 1990–1996, while the γ-HCH load was growing (Table 5.15). After 1996 GUS discontinued publishing such data.

Data presented in Table 5.15 originate from measurements performed within the scheme of the State Environmental Monitoring, by the Voivodship Environmental Protection Inspections and by the Institute of Meteorology and Water Management. These measurements were continued after 1996 and presented in annual reports prepared by the Institute of Meteorology and Water Management for the Chief Inspectorate for Environmental Protection. From data of these reports concerning DDT in river waters, no clear tendency of decline during 1997–2001 could be noted. Fluctuations in water run-off are, to a great extent dependent on the hydrologic and meteorological conditions.

Since complete information on POPs concentrations in waters discharged from the Polish territory into the Baltic Sea, and specifically in respect of concentrations of all

Table 5.15. Loads of chloroorganic substances discharged from the territory of Poland into the Baltic Sea during 1990–1996

Type of pollution load	Years						
	1990	1991	1992	1993	1994	1995	1996
	tonnes/year						
γ-HCH	0.30	0.37	0.27	0.38	0.26	0.48	0.45
DDT	0.40	0.48	0.31	0.24	0.15	0.15	0.16
DMDT	0.60	0.38	0.08	0.11	0.07	0.10	0.02

Source: GUS – Central Statistical Office.

12 substances controlled by the Stockholm Convention was lacking, one of the project activities undertaken was the one time pilot study of the respective concentrations in the Vistula and Oder Rivers sections close to their mouths. Samples were taken in July 2002, when the water flow in the Vistula River was near the multi annual average, and the flow in the Oder River about 20% higher than the mean value for many years. Results of these measurements are presented in Tables 5.16, 5.17 and 5.18.

As the data quoted in Table 5.16 indicate, in spite of the fact that since many years chloroorganic pesticides have not been used in Poland, all of them are detected in river waters (5 compounds), bottom sediments (7 compounds) and in living organisms (8 compounds).

In the case of PCBs a similar trend as in the case of chloroorganic pesticides was noticed: some of the PCB congeners were not detectable in water but appeared in bottom sediments and in fish tissues. Additionally, their concentrations in water were lower in comparison to their content in the bottom sediments, and the latter one was lower than in the fish fat tissue. This is an indication of a definite process of accumulation of these substances primarily in aquatic organisms and next in bottom sediments.

Single measurements, presented above, do not provide for a credible determination of the load of POPs discharged into the Baltic Sea. However, for the purpose of comparison, such calculations have been carried out in respect of DDT and PCBs. The following results were obtained (Table 5.19).

Table 5.16. Maximum recorded concentrations of chloroorganic pesticides in close to mouth sections of Vistula and Oder Rivers in 2002

Compounds	River water [ng/l]	Bottom sediment [ng/g d.m.]	Fish [ng/g fat]
HCB	4.3	3.3	23.2
Heptachlor	27.9	94.6	0.7
Cis Chlordane	not detected	3.6	52.4
Trans Chlordane	not detected	13.4	not detected
Aldrin	15.3	10.3	16.9
Dieldrin	2.5	7.4	81.3
Endrin	not detected	1.5	1.1
DDT	53.2	2.4	25.3
Toxaphene	not detected	not detected	8.9
Mirex	not detected	not detected	not detected
Sum of pesticides in the most polluted sample	53.2	102.8	181.0

Table 5.17. Maximum recorded concentrations of polychlorinated biphenyls in close to mouth sections of Vistula and Oder Rivers in 2002

Compounds	River water [ng/l]	Bottom sediment [ng/g d.m.]	Fish [ng/g fat]
Polychlorinated biphenyls:			
• PCB 28	–	–	11.4
• PCB 52	1.5	2.0	20.3
• PCB 101	not detected	2.4	37.4
• PCB 118	not detected	0.9	68.1
• PCB 138	not detected	4.9	15.3
• PCB 153	4.9	6.9	81.7
• PCB 180	2.9	4.7	29.1
• PCB 189	not detected	not detected	–
Sum of PCBs in the most polluted sample	4.9	16.9	346.1
Coplanar polychlorinated biphenyls:			
• PCB 77	not detected	0.9	33.2
• PCB 126	not detected	0.1	22.7
• PCB 169	not detected	not decected	20.3
Sum of coplanar PCBs in the most polluted sample	not detected	1.0	69.9

If these values could be recognised as credible, they would confirm a slow down of the declining trend (or even an increase) of the DDT load discharged into the Baltic Sea from the territory of Poland (compare data for 1990–1996 published by GUS, Table 5.16). This conclusion requires checking and possibly correcting in the nearest future by the calculation of loads for all available data on concentrations of DDT and PCBs at the sites close to the Vistula and the Oder River mouths.

5.6. POLLUTION OF THE GDAŃSK BAY

Most systematic tests of DDT and PCB content in costal seawaters are conducted at the Gdańsk Bay (4 measurement points). Concentrations of the sum of PCBs (7 congeners: 28,52,101,118,138,153,180) oscillate from 0.8 to 1.3 ng/l, while the Σ DDT (DDT+DDE+DDD) from 0.1 to 0.2 ng/l. During the period of 1992–2000 concentrations of DDT and PCBs were quite stable with a very small falling trend. However, accumulation of these substances in the bottom sediments of the Gdańsk Abyss has been observed.

Table 5.18. Maximum recorded concentrations of dioxins and furans in close to mouth sections of Vistula and Oder Rivers in 2002

Compounds	River water [ng/l]	Bottom sediment [ng/g d.m.]	Fish [ng/g fat]
2,3,7,8 - TCDF	not detected	0.0038	0.071
2,3,7,8 - TCDD	not detected	0.00002	0.002
1,2,3,7,8 - Pe CDF	not detected	0.0015	0.178
2,3,4,7,8 - Pe CDF	not detected	0.0015	0.209
1,2,3,7,8 - Pe CDD	not detected	0.0037	0.143
1,2,3,4,7,8 - Hx CDF	not detected	0.0037	0.169
1,2,3,6,7,8 - Hx CDF	not detected	0.0002	0.247
2,3,4,6,7,8 - Hx CDF	not detected	0.0005	0.047
1,2,3,7,8,9 - Hx CDF	not detected	0.0002	0.045
1,2,3,4,7,8 - Hx CDD	not detected	0.0001	0.005
1,2,3,6,7,8 - Hx CDD	not detected	0.0009	0.056
1,2,3,7,8,9 - Hx CDD	not detected	0.0067	0.016
1,2,3,4,6,7,8 - Hp CDF	not detected	0.0003	0.018
1,2,3,4,7,8,9 - Hp CDF	not detected	not detected	0.058
1,2,3,4,6,7,8 - Hp CDD	not detected	0.049	0.032
OCDD	not detected	0.793	0.180
OCDF	not detected	0.204	0.058
Sum of PCDDs/PCDFs in the most polluted sample	not detected	0.836	0.645

Table 5.19. Load of DDT and PCBs discharged into the Baltic Sea (momentary data from July 2002)

Site of sampling	Concentration [ng/l]		Load [kg/year]	
	DDT	PCBs	DDT	PCB
Vistula River mouth:				
• left bank	19.05	0.64	–	–
• right bank	13.77	1.77	–	–
• average	16.41	1.20	160	22
Oder River mouth	not detected	1.31	0.0	24

– Not calculated due to lack of data on river flows.

6. ASSESSMENT OF HEALTH HAZARDS

6.1. INTRODUCTORY INFORMATION

The contemporary procedure of the assessment of health risks caused by chemical substances includes four basic elements:

- Identification of health hazards,
- Assessment of the relation: dose (concentration) – response (effect),
- Evaluation of exposure,
- Risk assessment (quantitative and/or qualitative assessment of health effects of exposure).

This procedure has been adopted by the majority of countries based on recommendations and decisions issued, among others, by the National Academy of Sciences in USA, by US EPA, the European Commission and WHO.

The fundamental condition for risk assessment is to obtain reliable data, related to all elements of risk assessment through compilation of data deriving from experimental or epidemiological studies. This condition is often not fully fulfilled. The reason for limited risk assessment opportunities is predominantly the lack of complete data concerning the magnitude of exposure. Limitations are also connected with the difficulties in definition of the actual connection between the specific indices of health problems with the exposure to specific chemical substances. In such cases risk assessment is limited to quality characteristics, indicating the potential risk of appearance of health effects by people exposed to chemical substances characterized by specific toxicological peculiarities and for which the threshold doses, concentrations or values of unitary carcinogenic risk were established.

Elaboration of a health forecast resulting from exposure to dioxins (PCDDs and PCDFs), polychlorinated biphenyls (PCBs) and hexachlorobenzene (HCB) has been initiated in Poland on the basis of the studies of the respective literature, the toxicological characteristics of the discussed chemical substances and the review of data concerning sources and magnitudes of exposure to specific substances in Poland.

Food is the prime source of exposure for people to the discussed POPs. Air and water represent in total less than 10% of their intake. Because of lack of data concerning the content of POPs in water and air, the risk assessment has been based on considerations of their intake with food products, in accordance with the guidelines on the FAO/WHO Food Code Commission. Wherever possible the Estimated Daily Intake (EDI) was taken into account by comparing it with the Acceptable Daily Intake (ADI) or the Tolerable Daily Intake (TDI).

When assessing the hazard of POPs to human health, two types of evaluations should be distinguished: the toxicological assessment, including permissible concentrations, exposure doses and routes on one hand and the cancer risk, thus the probability of contracting cancer disease or its specific type, on the other. In these terms the International Agency for Research on Cancer (IARC) classifies the 12 substances controlled by the Stockholm Convention as shown in Table 6.1. As demonstrated in Table 6.1, among the 12 substances covered by the Stockholm Convention no substances are included in group 1, the impact of which on humans was fully proved. Two substances have been classified as the category with presumable carcinogenic effect in human beings (group 2A: PCDD and PCB). Most of the chloroorganic pesticides have been recognized as substances with possible carcinogenic impact on humans (group 2B – 7 substances) and only 3 substances do not show any carcinogenic impact on the human organism (group 3: PCDF, dieldrin and endrin). Though the substances specified in Table 6.1 under items 5–12 are not allowed for marketing in Poland, thus they are neither produced nor used in this country, their residues are still found in surface waters, bottom sediments and living organisms (see Chapter 5). Concentrations of their residues found in foods are many times lower than those permitted according to health criteria. On the basis of data concerning food products only 4 substances have been assessed in this chapter, in terms of their impact on human health. PCDDs, PCDFs, PCBs and HCB, found everywhere in the Polish environment (though in small quantities), are singled out by the Stockholm Convention into a separate group of substances released into the environment as by-products of combustion and some industrial production processes.

Table 6.1. IARC's classification of POPs

No.	Name of compound (group of compounds)	Included into IARC group
1	Dioxins	2 A
2	Furans	3
3	Polychlorinated biphenyls	2 A
4	Hexachlorobenzene	2 B
5	Aldrin	2 B
6	Chlordane	2 B
7	Dieldrin	3
8	DDT	2 B
9	Endrin	3
10	Heptachlor	2 B
11	Mirex	2 B
12	Toxaphene	2 B

Data for calculation of exposure and risk for the 12 substances under the Stockholm Convention are available in the US EPA database, as well as in other analogous databases. However, application of these factors in a human risk assessment procedure faces serious obstacles in Poland, due to the lack of sufficient data on the exposure, standards of permissible levels of exposure and epidemiological studies evaluating health effects of exposure to POPs all over the country.

6.2. PERMISSIBLE CONCENTRATIONS OF POPs IN VARIOUS ELEMENTS OF THE ENVIRONMENT AND IN PRODUCTS

Table 6.2 shows the permissible concentrations of POPs (HCB, PCBs and PCDDs/PCDFs) commonly released to the environment through particular media and products. The data quoted originate from legal regulations being in force in Poland or administrative decisions (for instance, decisions of the Chief Veterinarian concerning dioxin tests in food products of animal origin, imported to Poland from the European Union).

6.3. ASSESSMENT OF HUMAN EXPOSURE TO PCBs, HCB AND PCDDs/PCDFs

6.3.1. Basis for exposure assessment

The simplest method to assess human exposure to chemical pollutants is the comparison of concentrations of such substances in air, water, soil or foodstuffs with the values of standards of permissible levels of concentrations in those environmental elements. The actual concentration can be established on the basis of the environmental monitoring measurements or calculated data, obtained by using computer models of dispersion of chemical substances in air, water and soil.

Application of even such simplified methodology for human PCB, HCB and PCDD/PCDF exposure assessment faces very serious obstacles in Poland, due to lack of systematic measurements of concentrations of such substances in specific environmental media as well as lack of credible models of their migration. The existing models, known from literature, are characterized by low verifiability, particularly in relation to substances known for their ability to re-emission.

In Chapter 5 some random or on-the-spot data concerning actual levels of PCB, HCB and PCDD/PCDF concentration in water, soil and bottom sediments are presented. These details do not provide a sufficient basis for a proper assessment of human exposure to these chemical substances in Poland. It can be assumed, on the basis of information from literature and taking into account the emission values of the discussed POPs into the air that the main source of PCBs, HCB and PCDDs/ /PCDFs are foodstuffs of animal origin.

Table 6.2. Permissible concentrations of HCB, PCBs and PCDDs/PCDFs in particular media and products

Media, products	Permissible concentration		
	HCB	PCBs	PCDDs/PCDFs
AIR			
● workplace	0.5 mg/m^3	1 mg/m^3	–
WATER			
● drinking water	0.10 µg/l	0.5 µg/l	–
WASTEWATER			
● treated wastewater discharged into waters or into the ground	0.003–3.0* mg/l of wastewater	–	–
● industrial wastewater discharged into municipal sewerage systems	2 mg/l of wastewater	0.1 mg/l of wastewater	–
SOIL, GROUND, SEDIMENTS			
● protected areas	–	20 ng/g d.m.	–
● farm land, forests, residential and recreation areas	–	20 ng/g d.m.	–
● industrial and transport areas	–	2000 ng/g d.m.	–
FOOD			
● cereal grains	0.01 mg/kg	–	–
● meat and meat products	0.2 (F) mg/kg	0.2 mg/kg	500 pg TEQ/kg
● milk and dairy products containing below 4% fat	0.01 mg/kg	0.1 mg/kg	–
● milk and dairy products containing more than 4% fat	0.25 (F) mg/kg	–	–
● eggs without egg shells	0.02 mg/kg	0.2 mg/kg	–
● tea leaves	0.01 mg/kg	–	–
● products for babies and small children up to 10% of fat	0.004 mg/kg		
● products for babies and small children, containing more than 10% of fat	0.24 (F) mg/kg	–	–

– Lack of data.
(F) As calculated per 1 kg of fat.
* The highest admitted daily mean value depending on the type of production.

6.3.2. Exposure to HCB

Content of HCB in food products. There are two sources of information about the content of POPs in food products and in biological material sampled from humans: (a) results of studies conducted by scientific research institutes and (b) the reports of the Soil, Plants, Farm Products and Food Quality Monitoring Council appointed by the Minister of Agriculture and Rural Development (Annex 5B). Concentration of HCB in raw materials and food products identified by different authors is presented in Table 6.3.

The data given in table 6.3 are in several cases higher than those presented below from monitoring measurements (Tables 6.4 and 6.5). These differences are caused by two factors: differences in measurement techniques and lapse of time.

Between 1995–1997 a permanent quality monitoring of plants, farm products and foods was initiated in 100 sampling sites and 9 fisheries within the coastal zone of the Baltic Sea. From 1998 the scope of monitoring measurements has been extended by increasing the number of measurement points to 300. The content of HCB was tested in carrots, potatoes and cereals. The maximum permitted residues were established among these farm products only for the cereals at the level of 0.01 mg/kg (see Table 6.2). No increased content of HCB was found in the tested material. In Tables 6.4, 6.5, 6.6 and 6.7 the summarized results of the HCB content monitoring in different products, mainly of animal origin, are presented.

Although HCB is not produced nor used in Poland, it can be found in the environment and food products. On the basis of the results of adequate monitoring measurements a conclusion can be drawn that the standards laid down by Polish regulations concerning permissible levels of HCB in food – the main source of human exposure – are compliant with a comfortable safety margin. Monitoring the quality of plants, farm products and food provides up-to-date and reliable data, which may be used for the assessment of human exposure. Lack of monitoring data concerning

Table 6.3. Content of HCB in food (in fat or products) in Poland

Material tested	Average content [mg/kg]	Number of samples	Year of the experiment
Cow milk	0.017	285	1994
Eggs	0.035	220	1994
Dairy products	0.025	75	1995–1997
Processed vegetables for children	0.004	63	1995–1997
Fish	0.004	42	1995
Fish products	0.034	45	1995
Pork fat	0.090	484	1991

Table 6.4. Content of HCB in the fat tissue of pork, cattle, game, cow milk and in muscles of carp in Poland

Material tested	Range of concentration [mg/kg]	Average value [mg/kg]
Pork	0–0.005	<0.001
Cattle	0–0.013	0.005
Milk	0–0.004	<0.001
Game	0–0.028	0.006
Carp	0–0.014	0.004

Table 6.5. Content of HCB in food products and in rape seed in Poland in 2000

Products	Range of content [μg /kg fat]	Average value [μg /kg fat]	Number of samples tested
Pluck meat, cured meat	0–18.0	4.9	392
Oils	0–6.0	3.3	224
Margarines	0–3.4	3.0	244
Rape seeds	0–43.0	3.0	223

Table 6.6. Content of HCB in kidney fat of slaughtered animals in Poland

Fat	Range of concentration [μg/kg fat]	Average value [μg/kg fat]	Number of samples tested
Goose	0–89.0	41.7	36
Turkey	0–3.3	3.0	53
Broilers	0–3.0	3.0	59
Lamb	0–4.0	5.0	12

Table 6.7. Content of HCB in raw fish and fish products in Poland

The tested material	Range of concentration [mg/kg fat]	Average value [mg/kg fat]	Number of samples tested
Raw fish	0.0011 – 0.084	0.017	190
Tinned fish	0.0015 – 0.022	0.0091	51
Tinned cod liver	0.0163 – 0.0539	0.036	16
Smoked fish	0.0014 – 0.0415	0.0068	152
Salted fish	0.0040 – 0.0194	0.0084	11
Pickles	0.0030 – 0.0146	0.0074	18

HCB content in potable water is less important for the evaluation of human exposure because of its poor solubility in water.

As far as hexachlorobenzene threats to the Polish population are concerned, the monitoring of food contamination by this substance is more important than the monitoring of the different elements of the environment.

Content of HCB in human biological material. Results of research concerning the HCB content in human biological material are quite fragmentary and include milk and fat tissue. Table 6.8 presents the results of some research projects carried out mainly during 1990–2001.

Tests of HCB content in samples of human biological material confirmed that exposure to these substances exists. However, a hygenic interpretation of its concentration in milk is impossible since no permissible levels of HCB in human biological material have been determined.

Assessment of human exposure to HCB. Accepting that the main route of human exposure to HCB in Poland is food, the assessment of exposure was carried out on the basis of HCB content observed in 2000 within the framework of soil,

Table 6.8. HCB content in human biological material

Tissue		Place of sampling	Date	Comments
Milk	Fat			
0.0016 mg/l	–	Warsaw-lactarium	1993	average of 62 samples
–	0.310 mg/l	Warsaw-hospital	1992	average of 277 samples; age from 10 to 80
0.0014 mg/l	–	Kraków*	1992–1996	average value
0.0019 mg/l	–	Katowice*	1992–1996	average value
–	0.260 mg/kg	Gdańsk, Skierniewice, Warsaw, Lublin	1975–1990	average value
34 900 pg/g fat	–	Brzeg Dolny**	2001	average of 10 samples
31 500 pg/g fat	–	Tarnów**	2001	average of 10 samples
22 600 pg/g fat	–	Włocławek**	2001	average of 10 samples

* Studies were carried out in seven cities (here only examples of Kraków and Katowice are quoted). Average concentration of HCB in samples taken in all 7 cities was equal to 0.002 mg/l, and the maximum 0.005 mg/l (in Kielce).

** Samples were confirmed particularly in locations, where manufacturers of chloroorganic substances and industrial waste incineration plants are situated.

plants, agricultural and food products quality monitoring scheme. It was acknowledged that results obtained in 1991–1997 in a number of research centres were outdated, and that the testing methods applied were not uniform, raising doubts when comparisons were made.

The Regulation of the Minister of Health and Social Care of 15 April 1997[14] sets up the maximum acceptable residues (MAR) as criteria for the product's quality assessment in foodstuffs. The criteria of exposure assessment are the quantities of substances taken in relation to the tolerable daily intake (TDI). Table 6.9 shows the data on HCB content in food products in the year 2000 expressed as % MAR. Concentrations presented above, except for the content found in goose meat, are low and do not exceed several per cent of MAR. The assessment of exposure was made taking into consideration the structure of intake of selected food products and calculating the TDI factor.

Table 6.10 shows the TDI of HCB per a statistical Polish citizen, calculated from the consumption structure of selected food products in 2000 and the average content of HCB in these products. The TDI of HCB, determined by WHO, amounts to 0.17 µg per kg of body weight. Concluding from data of Table 6.10, the daily intake by a person with 70 kg body weight amounts to 7.47 µg, which means that, as calculated per 1 kg of body weight, the intake is equal 0.107 µg/kg body weight/day, about 63% of the TDI.

According to WHO the total average daily HCB intake with food, air and potable water in the general population of Europe and North America lies between 0.0004 and 0.0030 µg/kg body weight/day.

Results of HCB content tests in fat tissue and human milk indicate past exposure of the women, on one hand, and provide the basis for baby's exposure through its mother's milk, on the other hand. Interpretation in the first instance is not complete since no methodical foundations for the assessment of human exposure, based on the content of chemical substances in the fat tissue, have been developed yet.

Exposure of babies fed by their mothers' milk can be assessed applying two criteria: the permissible content in baby's and small children food products containing no more than 10% of fat – 0.004 mg/kg and TDI – 0.17 µg/kg body weight.

The first criterion is fulfilled (Table 6.8). The HCB content in human milk (containing less than 10% fat) varies between 0.0008–0.0012 mg/kg and is lower than the permissible level equal to 0.004 mg/kg. The second criterion is also met because the

[14] Regulation of the Minister of Health and Social Care of 14 April 1997 amending the Regulation on maximum acceptable residues of chemicals applied in cultivation, protection, storage and transport of plants in foodstuffs (Dz.U. No. 43, item 273).

Table 6.9. Average HCB content in food products in 2000

Food product	Average content [mg/kg]	MAR [mg/kg]	% MAR
Pork	<0.001	0.2 (F)	0.5
Cattle	0.005	0.2 (F)	2.5
Milk*	<0.001	0.01	1.0
Game	0.006	0.2 (F)	3.0
Carp	0.004	0.2 (F)	2.0
Meat – pluck, cured	0.0049	0.2 (F)	2.5
Oils	0.003	0.2 (F)	1.5
Margarine	0.003	0.2 (F)	1.5
Rape seeds**	0.003	0.2 (F)	1.5
Goose	0.0417	0.2 (F)	20.8
Turkey	0.003	0.2 (F)	1.5
Broilers	0.003	0.2 (F)	1.5
Lamb	0.005	0.2 (F)	2.5
Raw fish***	0.017	0.2 (F)	8.5
Tins – without tinned liver	0.009	0.2 (F)	4.5
Tinned cod liver	0.036	0.2 (F)	18.0
Smoked fish	0.007	0.2 (F)	3.5
Salted fish	0.008	0.2 (F)	4.0
Preserves	0.007	0.2 (F)	3.5
Pickles	0.007	0.2 (F)	3.5

* Includes milk and milk products up to 4% fat.
** Oil seeds – the value as for fat was assumed.
*** No Polish standard for fish is available, the permissible content as for fat has been applied.
(F) – As calculated per 1 kg of fat.

calculated daily intake based on results obtained in 2001 (Table 6.8) lies between 0.072 and 0.112 μg/kg body weight and is lower from the actual TDI (0.17 μg/kg body weight).

The possiblity to predict health risks connected with exposure to HCB is limited to the comparison of the HCB intake with food to the tolerable daily intake – TDI. The daily intake of HCB with the food consumed is about 0.11 μg/kg body weight/day, i.e. about 63% of the TDI value (0.17 μg/kg body weight/day) recommended by WHO. Also, the daily HCB dose taken in by a baby with its mother's milk, as calculated from the data of the HCB content in human milk, amounting 0.8–0.12 μg/kg body weight/day, is found within the limits of TDI.

Table 6.10. Daily HCB intake with food in 2000

Food product	Consumption [kg/day per person]	Content [mg/kg]	Intake [mg/day per person]
Milk	0.180	0.001	0.00018
Meat – pluck, cured	0.138	0.049	0.00676
Poultry	0.045	0.003	0.00014
Fat	0.018	0.003	0.00005
Margarine and other vegetable oils	0.034	0.003	0.00010
Fish	0.014	0.017	0.00024
Total			**0.00747**

The above data may indicate that the exposure to HCB through consumption of products containing this chemical substance does not constitute a human health risk in Poland, all the more, since the remaining sources (air and drinking water) represent a negligible rate in the total exposure.

6.3.3. Exposure to PCBs

PCB content in foodstuffs. Levels of PCBs in food, raw materials and products obtained by various authors[15] in the years 1994–1997 are shown in Table 6.11.

More extensive data, obtained by uniform methods, were gained in 1998–2000, within the quality of plants as well as agricultural and food products monitoring scheme, under which the content of the PCB total (i.e. 7 factors of congeners marked: 28, 52, 101, 118, 153 and 180) was monitored. These results are presented below in Tables 6.12, 6.13, 6.14, 6.15 and 6.16.

Data of the Table 6.14 indicate that in many samples of kidney fat, collected from poultry, the content of polychlorinated biphenyls is higher than 250 µg/kg fat, e.g. for the MAR value of seven indicative PCB congeners, although the value of 100 µg/kg of the congener PCB 153 has not been exceeded in a single sample.

When comparing the results of tests performed in the year 2000 with the results obtained in previous years, a decline in the content of the total of seven PCBs indices in the tested groups of food products was observed. In relation to several samples of kidney fat from poultry and rape seeds an increase of the "dioxin content

[15] Detailed literature information referred to in this chapter is found in this Project's Technical Report GF/POL/INV/R.14 (see Annex 5A).

Table 6.11. Content of PCBs in foodstuffs in Poland (1994–1997)

Product	Average [mg/kg]	Number of samples	Date
Cow milk	0.003	285	1994
	0.0001	52	1998
Eggs	<0.001	220	1994
Fish	0.0034	42	1998
Citrus fruits	0.0002	64	1996/1997
Vegetables	0.0002	lack of data	1996

Table 6.12. Total PCB content in the carcass fat tissue of pork, cattle, game, cow milk and muscles of carp in Poland during 1998–2000

The tested material	Range of results [mg/kg]	Average [mg/kg]
Pork	0–0.66	0.0012
Cattle	0–0.13	0.0036
Wild boar and roe	0–0.03	0.0059
Cow milk	0–0.08	0.0024
Carp	0–0.28	0.0278

Table 6.13. Total PCB content in different groups of food products and in rape seeds in Poland in 2000

Product	Range of results [μg/kg fat]	Average value [μg/kg fat]	Number of samples
Meat products	25.0–328.0	153.0	392
Oils	96.0–152.0	130.9	224
Margarine	29.0–437.0	135.1	244
Rape seeds	35.0–331.0	138.8	223

Table 6.14. Total PCB content in fat tissue of poultry and lamb in Poland in 2000

Fat	Range of results [μg/kg]	Average value [μg/kg]
Goose	86.0–334.0	159.2
Turkey	38.0–335.0	177.9
Broilers	184.0–265.6	lack of data
Lamb	83.0–169.0	123.4

factor" – total indicative PCB, over the value of 250 µg/kg fat was found. The content of PCB residues in oils (and also in olive oil) does not constitute a hazard to consumer's health.

Table 6.15 presents changes in the total average value of PCBs (of seven congeners: 28, 52, 101, 118, 138, 153 and 180) in tested products and rape seed during 1998–2000, which indicate a falling trend.

Tests on the content of 7 PCB congeners were performed on 252 samples of food raw material and fish products (Table 6.16)

Summarizing, in no tested sample of processed fish, the permissible level of 2 mg of the PCB sum per 1 kg fat, as allowed in Dutch standards, was exceeded. When taking into account the results of earlier tests carried out in 2000 it can be concluded that the average content of the total PCBs in fish products and raw fish has been constantly going down in the recent years. There are indications that this results from improvement in purity of the Baltic Sea water on one hand, and the implementation of the Polish Standard, limiting the processing of cod livers to the size of 350 g, on the other hand.

Content of PCBs in the human biological material. Data published at the beginning of the 90s show the results of total PCB content in human milk without splitting them into specific congeners. On the contrary, tests carried out later do

Table 6.15. Average value of the total PCB content [mg/kg fat] in food products during 1998–2000

The tested material	1998	1999	2000
Meat products	269.1	212.0	153.0
Vegetable oil	178.6	228.4	130.9
Margarine	125.9	201.5	135.1
Rape seeds	414.4	229.3	138.8

Table 6.16. Content of the total PCBs in food raw material and fish products in 2000

The tested material	Range of results [mg/kg fat]	Average [mg/kg fat]
Raw fish	0.04–3.645	0.46
Tinned fish	0.021–0.92	0.12
Tinned cod liver	0.3–1.6	0.66
Smoked fish	0.024–0.75	0.09
Salted fish	0.036–0.196	0.084
Pickles	0.031–0.2	0.069

take into consideration the appearance of coplanar congeners. This allows for the calculation of the TDI applying the values of toxicity equivalents TEQ. During 1979–1992 the PCB level was measured in the fat tissue of men and women of different age. Table 6.17 presents the PCB content in human biological material in Poland.

Table 6.17. Content of PCB in the human biological material

Site of sampling	Date	Tissue		Comments
		Milk	Fat	
Warsaw-lactarium	1993	723 pg/g fat	–	Average of 62 samples
Wielkopolska Region	2000–2001	77.6 ±55.1 ng/g fat	–	12 samples, average for 13 congeners
Brzeg Dolny	2001	2.44 pg TEQ/g fat	–	In each city samples were taken from 10 women. Samples from one city were put together and 12 congeners were tested.
Tarnów		2.12 pg TEQ/g fat	–	
Włocławek		2.05 pg TEQ/g fat	–	
Skierniewice	1979	–	966 pg/g (570–1600)	Average of 3 samples. Non-*orto* coplanar PCB
Gdańsk	1990	–	774 pg/g (150–1400)	Average of 9 samples Non-*orto* coplanar PCB
Warsaw – hospital	1992	–	856 pg/g fat	Average of 277 samples, people's age from 10 to 80 years

– Data not available.

Assessment of human exposure to PCBs. The basic route of the Polish population's exposure is connected with the consumption of PCB contaminated foodstuffs. It results from the fact that PCB is present on the entire territory of this country as an effect of pollution circulation between the elements of environment, e.g. from soil to water, from water to air, from air to water, from bottom sediments to water, from water to living organisms (for instance, fish).

In Poland, in 2000 the Chief Veterinarian issued guidelines, which determine permissible content of PCBs in some food products. According to these guidelines the total content of PCBs (as a sum of selected indicative PCB congeners marked by the IUPAC numbers 28, 52, 101, 118, 138, 153 and 180), recalculated into fat in respect of food products should not be higher than:

- 0.100 mg of total PCB/kg fat – for milk and milk products,
- 0.200 mg of total PCB/kg fat – for meat and meat products, eggs and egg products, animal feeds and feed additives of animal origin.

Hence, the food quality assessment in Poland should be carried out in accordance with the above-mentioned guidelines assuming that the content of congeners has been determined. Assessments carried out during the last 2–3 years comply with these terms. Table 6.18 presents the PCB content in food products.

Information in Table 6.18 indicates that the total value of PCB content is low for many products and does not exceed the permitted standard of MAR. Exception is the tinned cod liver.

Data presented in this report cannot be used for the calculation of the PCB intake dose since no quantities of specific congeners are given. Taking into account that only two out of seven indicative congeners mentioned by the guidelines of the Chief Veterinarian – Nos. 118 and 180 – belong to dioxin-like biphenyls and on the ground of similarity to dioxins, their impact on humans may be assessed. For the remaining congeners, not included into the group of dioxin-like biphenyls, no standards of concentration were established.

Tests of human milk in the Wielkopolska Region (J. Lulek at al. GF/POL/INV/R.14) covered 13 congeners, including 6 considered as dioxin-like biphenyls i.e. Nos. 105, 114, 118, 156, 170 and 180. Knowing the balanced factors of toxicity in relation to 2,3,7,8 TCDD the average daily intake (ADI) was calculated equal to 4.3 pg TEQ/kg

Table 6.18. Content of PCBs in food products

Products	Average content [mg/kg fat]	% of MAR
Milk and milk products (MAR – 0.100)		
Cow milk	0.0024	2.4
Meat and meat products (MAR – 0.200)		
Pork	0.0012	0.6
Beef	0.0036	1.8
Wild boar and roe	0.0059	2.9
Carp	0.0278	13.9
Processed meat	0.1530	76.5
Goose	0.1592	79.6
Turkey	0.1779	88.9
Lamb	0.1234	61.7
Smoked fish	0.0900	45.0
Salted fish	0.0840	42.0
Tinned cod liver	0.6600	330.0

body weight per day. When taking into account that the intake is related to infants, the calculated value is the verge of a threshold recognized as impassable.

In 2002 analyses of the content of dioxin-like biphenyls in human milk sampled in Brzeg Dolny, Tarnów and Włocławek were carried out (P. Głuszyński, GF/POL/INV/R.14). Concentrations calculated in this study varied between 2.05 and 2.44 pg TEQ/g of fat, which means that the daily intake falls between 10.5 and 12.5 pg TEQ/kg body weight. These values are greater than those produced by J. Lulek. The difference can be attributed to the number of congeners and their relevant coefficients considered in calculations.

Contents of PCBs in fat tissue presented in Table 6.17 are rather of informative character about the past exposure, although, due to lack of a standard determining the permissible content in human biological material DSB, it is difficult to assess them in terms of their impact on the human health. Although testing of PCBs in foodstuffs indicates that the standards laid down by the guidelines of the Chief Veterinarian are met, according to studies of J. Lulek and P. Głuszyński the breast-fed babies are exposed to high PCB doses.

Information required for prognoses of the health risk, constituted by PCBs is limited to scanty data from literature concerning the contents of these substances in foodstuffs and human milk and to results of calculations on quantities of substances taken in with food.

According to data presented in Table 6.18 the intake of PCBs with food by an adult should not lead to a health risk. Such conclusion is based on the comparison of the total PCB contents in food products with the Guidelines of the Chief Veterinarian for these products. The estimated daily intake lies at the level of 0.578 ng/kg body weight/day. Estimate of expected health risk on the basis of the EDI is in this case not possible, because the toxicological and epidemiological investigations do not allow determining the TDI for PCBs.

Similarly as in the case of exposure to dioxins, infants belong to the group of relatively high exposure to PCBs. This is connected with the PCB content in human milk. The amount of PCB intake by infants during breast-feeding varies between 4.3 and 12.5 pg/kg body weight/day. These values exceed the threshold TDI value of 4.0 pg/kg body weight/day, recommended by WHO. Just like in the case of exposure to dioxins, the short period of exposure and the small rate of the PCB dose taken with mother's milk in relation to the lifetime dose should be considered. Nevertheless, also in this case the relatively low safety margin should not be ignored. For these reasons the need for further investigations of exposure to PCBs should be carried out to obtain representative results for the whole country which would allow adequate health risk assessment.

6.3.4. Exposure to PCDDs/PCDFs

Tests for the presence of dioxins in foodstuffs and the environment were not carried out in Poland, except for studies of A. Grochowalski and his collaborators (Table 6.19). However, this information does not present a sufficient ground for the assessment of human exposure in Poland. Results of PCDD/PCDF tests in human milk provide such opportunity with reference to exposure of babies in several locations. Table 6.19 presents the intake of dioxins [pg/TEQ/kg body weight/day] by babies with their mother's milk in Poland.

Table 6.20 shows the intake of dioxins (pg/TEQ/kg body weight/day) by breast-fed infants in Poland. The presented results prove that babies take large doses of dioxins with their mothers' milk, but the small number of tests performed makes it difficult to assess the sources of exposure.

Lack of data on exposure to PCDDs and PCDFs in Poland makes it impossible to predict the health risk resulting from exposure. Only very limited information on the dioxin content in human milk allows for making reference to the potential health risk in breast-fed babies.

According to Polish data presented in Table 6.20, the estimated daily intake of dioxins by breast fed babies ranges within 51–108 pg TEQ/kg body weight/day.

The TDI for dioxins, i.e. the quantity of substances which an adult can take in every day for life without a predictable detriment to his health, has not been determined in Poland. The value of TDI established by WHO is 1–4 pg TEQ/kg body weight/day. No separate TDI was set for adults, babies and children. Comparison of estimated daily dioxin intake with mother's milk (EDI) with the WHO recommended TDI indicates, that the daily dioxin intake in breast fed babies exceeds the TDI by about one hundred times. This would suggest a considerable increase of the babies and children health risk. However, attention must be paid to the fact that the WHO established TDI refers to the daily dioxin intake during lifetime. The WHO Working Group of experts involved in the assessment of health risk caused by dioxins has acknowledged that the calculated life-time dioxins' dose equal to 1800 ng TEQ is more significant than the total amount of dioxins (about 80 ng TEQ) taken during the short period of baby's breast feeding time amounting to about 4% of the lifetime dose. Moreover, the WHO experts draw attention to the fact that the gain of fat tissue in babies, during an average of six months of breast feeding, causes an effect of "dilution", i.e. reduction in dioxin content in the fat tissue and as a consequence, it reduces considerably the differences in dioxin content in the target organs between the baby and the adult.

It can be recognized after WHO that, in the light of the quoted data, the content of dioxins in mothers' milk does not present a contradiction to natural feeding. On the

Table 6.19. Content of dioxins in food products of domestic and foreign origin in 1999 (Grochowalski et al., see Appendix 5b)

Products	Range of content [pg TEQ/g fat]	Reference data from other countries* [pg TEQ/g fat]
Sea fish (Baltic fish)	7.0–40.0	2.4–214.3
Fish oil from Baltic Sea fish	11.2–40.0	–
Fish oil from Baltic Sea fish (import from Scandinavia)	–	–
Pork grilled on open fire (charcoal)	20.0–25.0	–
Poultry	0.6–12.8	0.7–2.2
Freshwater fish	1.2–9.4	2.4
Beef	2.4–8.5	0.1–16.7
Cheese	0.2–7.7	–
Eggs (yolk)	0.6–7.4	1.2–4.6
Butter	0.6–6.5	0.16–4.8
Milk powder	0.3–5.0	–
Milk	0.1–4.0	0.5–3.8
Beef tallow	3.8	–
Yoghurt with more than 2% fat	0.1–1.8	0.18
Pork	0.05–1.3	0.31

* Source: „Persistent organic pollutants in Poland" Waste Prevention Association „3R", Kraków 2001.
– not investigated.

Table 6.20. Intake of PCDDs/PCDFs by babies on the basis of analysis of human milk in five cities in Poland

Intake [pg/TEQ/kg body weight/day]	Place of sampling	Year	Comments
108*/49*	Katowice	1992	TEQ was calculated basing on the Nordic Model* and US EPA Model**
51.10	Bytom	1989	Calculated on the Nordic Model
90.48	Brzeg Dolny	2001	Calculated basing on the Nordic Model assuming babies' body weight at 5 kg, 80% of fat absorption and consumption of 800 g of milk/day
86.74	Tarnów		
93.79	Włocławek		

other hand the fact alone that the daily dioxin intake by the infants together with their mothers' milk can be even one hundred times higher than the TDI value of an adult, is a good reason for anxiety, having particularly in mind, that the developing organism is most prone to toxic effects of chemical substances. Therefore, it seems that despite of the lack of proved evidence of health risk resulting from dioxin intake with mother's milk, activities aimed at reduction of dioxin emissions to the environment and lowering the level of exposure is indispensable.

Limited data on dioxin content in the Polish women milk are far from being representative and therefore should be treated highly cautiously. Countrywide cross-section studies on dioxin exposure are urgently required.

PART II

ASSESSMENT OF THE NATIONAL INFRASTRUCTURE AND PREPAREDNESS FOR THE IMPLEMENTATION OF THE STOCKHOLM CONVENTION

7. NATIONAL LEGAL REGULATIONS AND OTHER MECHANISMS

7.1. STOCKHOLM CONVENTION PROVISIONS VERSUS POLISH LEGISLATION

All international agreements, ratified by Poland, constitute part of the national legal system. They are applied directly, unless their application, in accordance with Article 91, paragraph 1 of the Constitution of the Republic of Poland, requires the national law to be issued. With reference to the Stockholm Convention the ratification process has been initiated. Obligations resulting from the implementation of the Stockholm Convention require introducing new legislation into the Polish legal system. Table 7.1 presents a compilation of the provisions of the Convention with the binding Polish law as of July 1, 2003, indicating the necessary amendments of the existing legal acts.

Among the existing regulations only Article 38, paragraph 5 of the Waste Law[8] of 27 April 2001 may rise doubts in the light of the respective provisions of the Convention. According to the latter (Article 6, paragraph 1) the POPs waste (hence, PCBs) should be irreversibly transformed in the process of destruction. The ban on PCB recovery, expressed by the Law on Waste is clearly formulated, nevertheless, the Law allows a number of exceptions, and those exceptions cause discrepancies. Other provisions of the Stockholm Convention may be introduced to the Polish law by enacting appropriate executive regulations as enabled by the Waste Law of 27 April 2001, the Environmental Protection Law[7] and the Law on Chemical Substances and Preparations of 11 January 2001[16].

[16] Dz.U. 2001 No. 11, item 84; as amended.

Table 7.1. Provisions of the Stockholm Convention on Persistent Organic Pollutants vs. Polish law (as of 1 July 2002)

Stockholm Convention		Polish legislation	Comments
Article	Provisions*	Normative act, regulation	
1	2	3	4
3	**Para.1**. (a) Prohibition and/or undertaking the legal and administrative measures necessary to eliminate: (i) Production and use of the chemicals listed in Annex A (aldrin, chlordane, dieldrin, heptachlor, hexachlorobenzen, mirex, toxaphen, PCB) (ii) Import and export of the chemicals listed in Annex A in accordance with the provisions of para.2;	**Article 31 para.1 of the Law on Chemical Substances and Preparations**[16] contains the delegation under which the regulations specifying the prohibitions, restrictions of terms of production, turnover or use of hazardous substances or preparations may be introduced.	The rules concerning the ban on POP production, covered by the Convention provisions, do not exist in the present Polish law. Full implementation of the Convention will require issuing the regulation concerning substances listed in Annex A and Annex B, based on Article 31 para. 1 of the Law.
	(b) Restricted production and use of the chemicals listed in Annex B (DDT) **Para. 2.** Take measures to ensure: (a) that a chemical listed in Annex A or Annex B is imported only with the purpose of: i) Sound disposal as set forth in paragraph 1 (d) of Article 6; or ii) Use or application for purposes permitted under Annex A of Annex B;	**Article 160 para. 1 of the Environmental Protection Law**[7] forbids marketing or re-use of substances constituting particular environmental threat, including PCB only from the substances under control **(Art. 160 para. 2)**	Implementation of the delegation as contained in Article 160 para. 3 of the Law by recognition of the remaining controlled substances as constituting a particular threat to environment is necessary to ensure the fulfilment of the obligation laid down by Article 3 para. 1 of the Convention.
	(b) Export of chemical substances listed in Annex A or Annex B only: i) For the purpose of safe disposal as set forth in paragraph 1 (d) of Article 6; or ii) For a use or purpose which is permitted for that party under Annex A or Annex B iii) To the State, being not the	**Article 65 of the Waste Law**[8] sets the conditions for acceptability of importation of hazardous waste. Import of hazardous waste is restricted to types of wastes, defined by the Regulation of the Minister of the Environment,	Import of PCB-containing waste is presently not allowed, though opportunities cannot be excluded in the future. Provisions of Article 3 para. 2, in connection with Art. 6 para. 1 of the Convention admit the possibility of

1	2	3	4
3	Party to this Convention which provided the certificate, specifying the type of the intended use of that chemical and stating the obligation of protecting human health and environment and observing the provisions of art. 6 para. 1 and provisions of para. 2 part II of Annex B; (c) Prohibition of exporting chemicals listed in Annex A, for which specific production and use exemptions are not longer in effect, except for export with the aim to eliminate it according to art. 6 para. 1 (d). **Para. 3.** Preventing the production and use of new pesticides and industrial chemical substances which, on the basis of criteria contained in Annex D para. 1, reveal POP characteristics. **Para. 4.** Application of criteria defined in Annex D para. 1 for the assessment of the currently used pesticides or industrial chemical substances; **Para. 5,** para. 1 and para. 2 shall not apply to the quantities of chemicals used for laboratory testing purposes; **Para 6.** Minimization of environmental releases of substances used under the regulations, excluding them from the rules of the present Convention	being issued on the grounds of the delegation of Article 65 para. 4 of the **Environmental Protection Law.** The permit for import of hazardous waste may be granted, among others, on the condition that the imported waste will be subjected to recycling processed within the country or abroad, excluding the activities R10 as mentioned in Annex 5 to the mentioned Law. Use and turnover of substances controlled by the Convention, being the components of the plant protection chemicals are the subject of the **Cultivated Plant Protection Law**[1] and executive acts, being issued on its basis, including the **Regulation of 5 March 2002**[2]	importing the substances as listed in Annex A or Annex B exclusively with the aim of their safe elimination. On the basis of the mentioned legal acts the application of the substances under control, as components of plant protection, chemicals, <u>is</u> <u>forbidden</u> in Poland.
4	Cooperation with the Secretariat of the Convention in respect of the register of specific exemptions		To be introduced after the Convention is ratified.
5	Measures to reduce or eliminate releases from the unintentional production. Development	**Environmental Protection Law**[7] in chapter “Counteracting	The obligatory rules allow understanding the action aimed at

1	2	3	4
5	of the National Action Plan – during 2 years since the entry of the Convention into life – in order to identify and characterise the releases of substances as listed in Annex C (PCDDs/PCDFs, HCB, PCBs) and undertake the activities enabling prompt, considerable reduction of the level of releases or elimination of emission sources.	pollution" contains the rules, specifying the requirements which have to be met by the installations or equipment under the use in respect of observing the standards of emissions, the applied technologies, performing the emission measurements and submitting their results to the competent organs and obtaining emission permits, required by the law **(Art. 137–151 and 280–181)**. The action plan is determined by the ecological policy of the state (**Art. 13–16 of the Law**) and the programmes of environmental protection **(Art. 17 and 18 of the Law)** **Article 41 para. 1 (b) of the Water Law**[20] introduces the absolute ban on introduction of only DDT and PCB from among the controlled substances, into water and soil. Based on the Water Law, the standards concerning aldrin, dieldrin, endrin and HCB content have been introduced. The following is to be determined: – Admissible weight in the purified industrial wastes (**Regulation of the Minister of the Environment**[21]),	reduction or elimination of releases from the unintentional production. The appropriate regulation, specifying the standards of emission from POP installations will soon be issued. The delegation contained in Article 206 para. 2 of the Environmental Protection Law enables determination, on the way of regulation, of the minimum requirements, resulting from BAT, including POP emission from installations if there is a need of ensuring the uniform approach to issuing the integrated permits on the territory of the whole country. Due to the duty of introducing the requirement of BAT application for the new emission sources, as listed in part II of Annex C to the Convention at the latest date of 4 years since its entry into force, the regulation should include the mentioned installations.

1	2	3	4
		considerable pollution of individual elements of nature or environment in general. The action plan is defined by the National Environmental Policy (Articles 13 – 16) and environmental protection programmes (Articles 17 and 18 of that Law).	embraced, by the requirement to obtain the integrated permit simultaneously because of the duty to introduce the requirement of applying BAT for the new emission sources included in the part II of Annex C to the Stockholm Convention not later than 4 years after coming in force. The said order should cover just these installations.
6	Measures to reduce or eliminate releases from stockpiles and wastes. **Para. 1.** Develop appropriate strategies for identifying: stockpiles, products and articles in use and wastes consisting of chemicals listed in Annex A, B and C	Two Regulations of the **Minister of Economy** are dealing with the PCB issue, which introduced in 2002, among others, the obligation to: – make subject to inspect equipment and installations on PCB presence, – determine PCB content using gas chromatography method, – mark and put on record all equipment and installations submitted for inspection and PCB content determination, as well as Article 162 of the Environmental Protection Law, concerning the duty of periodical submission of information to the voivode on type, numbers and places of PCB occurrence, and regulations of the Law on Waste Management Article 38 para. 7 requiring insertion into the waste registration card the information about PCB content.	For other substances specified in Annexes A and B prohibition of turnover or repeated use of controlled substances on principles determined by the regulations of the Environmental Protection Law (Articles 160-163) is required. With reference to wastes amendments of the Law on Waste Management are required.

1	2	3	4
		– introduce the duty of removing PCB from waste before its recovery or neutralisation **(Art. 38 para. 2);** – recommend PCB combustion in incineration plants for dangerous waste **(Art. 38 para. 4)** where the energy recovery takes place; – introduce exceptions from the ban on PCB recovery **(Art. 38 para. 5)**; – introduce the obligation to place the information on PCB content in the waste, on the waste record card **(Art. 38 para. 7)**	requires legislative action aiming at exclusion of material recovery of waste containing substances subject to the Convention in order to eliminate the collision with the Waste Law provisions with Article 6 para. 1 (d) of the Convention. This amendment must also include the ban on recovery of other POP-containing substances and products and ensure neutralisation of such substances according to the requirements of the Convention.
	Para.2. Cooperation with the Basel Convention bodies in the matter of control of trans-border movement of hazardous, POP-containing waste		The Basel Convention was ratified by Poland on 20.03.1992. The Environmental Protection Inspection is the responsible body and focal point.
7	Development of a plan for implementation of obligations under the Convention and control of its execution		The proposal of developing the national programme for implementation of the Convention will be established within the GEF Project
8	Cooperation with the Secretariat of the Convention in respect of enlisting the substances in Annexes A, B and C according to criteria specified in annex D; development of the risk profile in accordance with Annex E. Analysis and preparation of conclusions in this respect.		Tasks will be formulated by the focal point (national secretariat of the Convention) after its ratification.

1	2	3	4
9	The responsibilities in the respect of information exchange between the Parties via Secretariat of the Convention (establishment of the national focal point in accordance to para. 3)		Proposals on establishment of the national focal point will be developed within the GEF Project activities
10	Public information and education of the society	**Articles 77–78 and Articles 19–24 of the Environmental Protection Law** specify the responsibilities concerning information on the state of environment and the results of the state environmental monitoring. The rules of the **Law of 6 September 2001 on the access to public information**** contain the regulations related to the right to information on environment which bear the character of public information	Conducting inventories of emission sources and POPs activity in accordance with the provisions of the Convention and the Decision of the European Commission requires creation of information collecting system on the level of individual sources similar to EPER or PRTR.
11	Research, development and monitoring	The rules of **Articles 25–30 of the Environmental Protection Law** and of **Articles 2** and **23–28 of the Law on Environmental Protection Inspection**[17] constitute the foundations of the environmental monitoring system providing for collection and distribution of information on the environment. **Article 79** of the Environmental Protection Law contains the recommendations for administrative bodies and scientific research centres to consider the research programmes of environmental protection	

1	2	3	4
11		environmental protection problems in their research activities.	
12	Technical assistance for developing countries and the countries under the economic transformation		Granting such assistance should be considered in bilateral agreements of cooperation in respect of environment management and protection. The Government should create the conditions encouraging Polish enterprises to participate in such assistance.
13	Financial resources and mechanisms aimed at financial support of the developing countries		In the future, undertaking of political decision, depending on Party's own possibilities will be necessary.
15	Reporting: The duty of submitting the reports on activities, statistical data concerning production, export and import.		To be introduced after ratification by the appointed bodies

* Abstract from the provisions of the Stockholm Convention being called hereinafter in Table 7.1 "the Convention", imposing the duties that require introduction into national regulations or the action to be undertaken by the Party.

** Dz.U. 2001, No. 112, item 1198.

Chemical substances covered by the Stockholm Convention, mentioned in Annexes A and B, except for PCBs, belong to active compounds of plant protection chemicals (pesticides). It must be explained that the regulations of the Law on Chemical Substances and Preparations do not refer to plant protection chemicals (Article 1, paragraph 3, item d), but substances being components for production of such chemicals, thus their active compounds are subject of that law. The Law on Protection of Cultivated Plants of 12 July 1995 regulates the issues concerning use of pesticides. The Regulation on detailed rules for issuing permits admiting plant protection chemicals for marketing and use of 5 March 2002, based on that Law provides, in the Annex 9 "Biologically active substances banned from use as constituents of plant protection chemicals in Poland", a list of all substances subject

[17] Consolidated text: Dz.U. No. 112, item 982; as amended.

to the Stockholm Convention. Thus, the conclusion may be drawn that the use of pesticides, containing compounds covered by the Stockholm Convention is legally prohibited in Poland.

7.2. ENVIRONMENTAL PROTECTION LAW

The Polish Environmental Protection Law[7] establishes the duty to update periodically the National Environmental Policy, develop the system of granting permits for environmental emissions of energy and substances determining the relevant conditions, including application of environmental quality standards, best available techniques and environmental monitoring as well as terms for collection, processing and release of information concerning the use of environmental resources. Regulations particularly significant for issues concerning the reduction and elimination of POPs-like substances are inserted under the Chapter "Pollution prevention". The Law establishes here a ban on marketing and re-use of substances posing particular environmental threat (Article, 160 paragraph 1), identifying PCB as such a substance (Article 160, paragraph 2) and authorizes the Minister of the Environment to define other substances as particularly hazardous to the environment, hence also persistent organic pollutants covered by the Stockholm Convention.

Provisions of the Law on Environment Protection (Articles 137–151, 180–181 and specifically Articles 144, 145) concerning basic requirements, which must be fulfilled by installation in operation provide for the initiation of activities set forth by Article 5 of the Convention aimed at reduction/elimination of unintentional releases. However, to fulfil it, issueing of the respective regulation will be necessary, according to Article 146, paragraph 2 of the Law as well as a gradual restriction of conditions laid down by the regulations concerning emission standards (Article 145), in relation to installations listed by Annex C to the Stockholm Convention, and particularly those, which according to existing regulations, are not subjected to obtain integrated permits. Articles 77–80 of the Law provide for public information and education (Article 10 of the Convention). Similarly, Articles 25–30 of the Law ensure scientific research and monitoring activities on POPs (Article 11 of the Convention). Such documents as the National Environmental Policy (Articles 13–16 of the Law) and Environmental Protection Action Plans (Articles 17 and 18 of the Law) ensure initiation and implementation of plans aimed at identification, reduction of levels of emission and elimination of the sources of POP emission (Articles 5 and 6 of the Convention).

Following the pattern of the European Union legal regulations, Part II of the Environmental Protection Law sets forth provisions, important in terms of the statements of the Convention, concerning installations, equipment, substances and products. Referring to installations and equipment it requires that their use should not lead to emissions exceeding the established standards and the impact of neither installations nor equipment should not cause considerable worsening of the state of the environment nor threatening human life or health. This is an outstandingly important interference into production processes and industrial production facilities. Poland was the first country to apply this idea in such a form.

The Law is broadening the catalogue of permits for the use of installations as compared with the scope applied so far by introducing integrated permits, in connection with the implementation of the EU IPPC Directive[18]. It introduces new regulations concerning implementation of a set of techniques from the scope of the best available techniques – BAT. Importance of that regulation requires some explanation. For a number of years an annual inventory of PCDD, PCDF, PCB and HCB emissions from unintentional production of those pollutants has been carried out in Poland. This inventory takes into account specific production installations and installations of thermal waste destruction, volume of the capacities and their technical state. The IPPC Directive, hence the Environmental Protection Law, covers all production facilities and waste incineration plants, which according to the current state of knowledge, releases of the four substances listed in Annex C to the Stockholm Convention into air, as well as through generated wastewater, wastes and manufactured products. The same four substances are listed in the Annexes to the IPPC Directive, the emission of which should be reduced. Introduction of integrated permits and the BAT system are of significant importance for the implementation of the Stockholm Convention resolutions.

Moreover, the Environmental Protection Law, under its Chapter IV, regulates the issues of preventing industrial accidents. It defines accurately the legal instruments concerning prevention of major industrial accidents, the duties of the management of facilities likely to cause industrial accidents and the duties of administrative bodies linked with such accidents. It should be stressed that industrial accidents may, in some instances, unintentionally cause formation of the above mentioned substances classified as POPs. These regulations are synonymous with the introduction into the Polish economic practice of the regulations of the so-called EU Seveso II Directive.

7.3. LAW ON CHEMICAL SUBSTANCES AND PREPARATIONS

The Law on Chemical Substances and Preparations[16] sets conditions, prohibitions or restrictions for production, marketing and use of chemical substances and preparations in order to prevent the negative effects of these substances and preparations

[18] Directive on integrated pollution prevention and control.

on human health or the environment. It regulates proper classification of these substances based on the criteria of hazards they constitute to human health or the environment, and introduces description cards as an indispensable condition for their handling, establishes the post of the Inspector for Chemical Substances and Preparations reporting to the Minister of Health. This Law indicates administrative bodies competent for determination of human health and environmental risk assessments, establishes the duty to inform the inspector about hazardous preparations introduced for marketing on the Polish territory and the duty to test the chemical substances and preparations, methods of labelling, packaging, marketing and use of hazardous substances and preparations.

In case an unreasonable risk to human health or environment occuring as a result of production, marketing or use of hazardous substance or preparation or resulting from international agreements, the Article 31 of that Law authorises the Minister of Economy to establish, on request of the Minister of Health or the Minister of the Environment, the necessary restrictions, bans or conditions by the way of the regulation of the Minister of Economy for:

- Production, marketing or use of such substances or preparations,
- Specific applications of such substances or preparations,
- Specific use in concentrations or proportions exceeding certain levels.

The Law states that in cases required by international agreements, the production, marketing or use of hazardous substances and preparations need permission of the Minister of Economy.

The Sanitary Inspection is supervising the adherence to the regulations of the Law on Chemical Substances and Preparations by bodies introducing substances and preparations to the market and using them in their professional activities. In addition to that:

- The Environmental Protection Inspection – with reference to environmental threats,
- The National Labour Inspection – with reference to supervision and control of compliance with the regulations of the Law by employers,
- The Trade Inspection – with reference to labelling single packages of hazardous substances and preparations in gross and retail sales,
- State Fire Service – with reference to proper marking of places of stockpiling of substances and preparations,
- Border Guards and Customs Services – with reference to compliance with the bans concerning imports of substances and preparations into the Polish territory.

In terms of introducing the regulations of the Stockholm Convention into the Polish law the provisions of Article 31 are particularly important because they authorises the introduction by a regulation of a ban, restriction or establishment of conditions for production, marketing or use of substances or preparations. Implementation of this delegation shall demonstrate the implementation of obligations provided by Article 3 of the Stockholm Convention. Provisions of the Law on Chemical Substances and Preparations seem to present coherent legislation fulfilling requirements needed to implement the obligations laid down by the Convention, provided the Minister of Economy and Social Policy shall satisfy the delegation of Article 31 of the Law.

Detailed proposals for changes in the Polish legislation necessary for the implementation of the Stockholm Convention provisions, as output of the GF/POL/01/004 Project, will not provide proposals for changes in the Law on Chemical Substances and Preparations because neither of the substances mentioned under Annexes A and B to the Convention are produced in Poland intentionally. The unintentional production of substances mentioned under Annex C takes place in Poland but the conditions of its reduction is subject of the Environmental Protection Law.

7.4. LAW ON WASTE

According to the Stockholm Convention any stockpiles of substances or preparations containing substances listed in its Annex A and Annex B are regarded as waste in countries becoming Parties to the Convention. In accordance with the Law on Waste[8] all these materials were classified as hazardous waste, provided that the concentrations of the above mentioned substances, exceed specific values of threshold concentrations[19].

Particular requirements in relation to POPs waste are defined in Article 6 of the Stockholm Convention. These regulations refer to the requirement of irreversible transformation of the substances in the process of waste destruction and do not allow for recycling (material recovery). Similarly, the Law on Waste prohibits recovery of PCBs as set forth in Article 38, paragraph 1, however, admission of the waste treatment process (D9 process) for one of the possible methods based on Article 38 paragraph 5 of the Law is doubtful.

It will be necessary to amend the Law on Waste by including a clear prohibition for material recovery from waste covered by the Stockholm Convention and the condition of irreversible transformation of POPs in the process of their destruction.

[19] For PCBs – 0.005% according to Article 3, paragraph 17 of the Environmental Protection Law and for other substances in the executive regulation to the Law on Waste.

7.5. WATER LAW

Legal regulations concerning releases of POPs into water and soil are also included in the Water Law and executive acts based on that Law. The Water Law dated 18 July 2001[20] sets out, among others, the principles of water management in a broad sense including, among others, setting orders, prohibitions and restrictions aimed at maintaining good environmental quality of waters.

In terms of implementing provisions of the Stockholm Convention, of particular importance is the duty addressed by the Law to all water users, including, which is significant, ordinary water users, to comply with the requirements concerning the quality of wastewater discharged into water bodies and to the soil. These requirements cover also the concentrations of substances subject to the Stockholm Convention. Additional standards to be complied with by wastewater discharged into water bodies are laid down by executive regulations issued by the Minister of the Environment based on delegations of Article 45, paragraphs 1–2 of the Water Law. From the analysis of the mentioned regulatory acts it may be concluded that the concentrations of substances controlled in wastewater are regulated in four ways:

- Establishing unconditional prohibition to discharges of some substances controlled by the Convention (DDT and PCB) into water or soil – Article 41, paragraph 1b of the Water Law;
- Determining the permitted amounts of substances, which may be released in treated industrial wastewater per unit of raw material, material, fuel or final product used. Standards for aldrin, dieldrin, endrin and HCB in this respect are regulated by the Regulation of the Minister of the Environment of 31 January 2003 on allowed amounts of substances which may be discharged with industrial wastewater, issued on the authorisation of the Article 45 paragraph 2 of the Water Law;
- Determining maximum permitted values of aldrin, dieldrin, andrin and HCB concentrations in treated industrial wastewater. Standards in this respect are set by the Regulation of the Minister of the Environment of 29 November 2002 on conditions for discharging wastewater into water bodies and soil and on substances particularly hazardous to the aquatic environment (Dz.U. No. 212, item 1799) issued as authorised by Article 45, paragraph 1 of the Water Law.
- Determining maximum permitted pollution standards for industrial wastewater originating from stack gases cleaning processes and processes of thermal transformation of waste concerning dioxins and furans in the form of totals of individual dioxins and furans. These standards were introduced compliant with the

[20] Dz.U. 2001, No. 115, item 1229; as amended.
[21] Dz.U. 2001, No. 35, item 309.

mentioned Regulation of the Minister of the Environment of 29 November 2002, though they will not come into force not before 28 December 2005 (provisions of the Regulation are valid from 1 January 2003).

7.6. ASSESSMENT OF EFFICIENCY

Full assessment of efficiency of legal regulations concerning POPs problems is presently not possible, for the majority of those regulations are in the initial stage of their application. This is particularly relevant in respect to integrated permits, but also with reference to laws concerning chemical substances and preparations. Knowledge of the Stockholm Convention provisions obligatory in the administration of industry and economy is, in average, rather low. However, the initial results of activities within the area of chemical substances and preparations must be assessed as positive. Legal regulations concerning plant protection and plant protection chemicals should be highly appreciated. Their implementation over many years in a form close to the currently valid Law on the Protection of Cultivated Plants contributed to the elimination of substances controlled by the Stockholm Convention in this sector. It can be expected that the regulations of the Environmental Protection Law shall be effective to the same extent in reduction and elimination of substances subject to the Stockholm Convention. After joining the EU by Poland the industrial and municipal sectors will need to meet high environmental protection standards of the EU regulations, which were announced by the proposal of the European Parliament and the EU Council Regulation on persistent organic pollutants of June 2003. To fulfil the tasks, only in respect of reporting to the European Union on POPs, it will be necessary to extend the knowledge and access to available information on the state of pollution caused by POPs, their emission to air and relases into water and soil and their effect on the environment and human health. The main reason for the establishment of the above mentioned legal acts was the need to harmonise the Polish law with the EU legislation. Thus, it can be stated that the Polish legislation is compliant with the EU law, though, having in mind the dynamics of changes of the latter in the area of environmental protection, further amendments of the Polish legal regulations will be required in future.

It must be admitted that the regulatory system related to plant protection and plant protection chemicals is functioning efficiently. This statement is justified by many years of implementation of this set of regulations in a form very similar to the present Law on Cultivated Plant Protection[1].

There are good reasons to expect high efficiency of legal regulations concerning substances subject to the Stockholm Convention. Apart from relevant Polish regulations, the industry and municipal services will be subject to restrictions of the European

Union regulations after Poland becomes its Member State. Just to cope with the tasks of the EU reporting system on POPs a much deeper knowledge of the actual situation in the industry and municipal services will be required by the respective authorities. Obviously, it will positively affect the average level of law enforcement.

One of the substantial grounds for the development of the above-mentioned legal acts was the regulatory system of the European Union. Each draft of those laws and each law itself at the final stages of the legislative process were subject to control by the Committee of the European Integration and by the interested organisations in terms of their compliance with the EU provisions. Thus, it can be confirmed that these laws are conformable with the legislation of the EU. Apart from the EU regulations the Polish law obviously contains solutions reflecting the specific administrative division of Poland, structure of central and local government, competencies of ecological funds etc. This, however, does not contradict with the EU law.

7.7. THE ROLE OF ENVIRONMENTAL FUNDS

Environmental funds, foundations and banks belong in Poland to the most important institutions acting in the environmental protection domain. They are, parallel with the budget resources being at disposal of all levels of administration (central, voivodeship, *poviat* and *gmina*), the fundamental source for financing not only environmental protection projects but also a great number of other ecological activities (planning and programming, expert studies, upgrading of organizational structures, education and training, extension and publication activities and many others).

The financial resources of environmental funds (National Fund for Environmental Protection and Water Management, 16 voivodeship funds, 373 *poviat* funds and 2489 *gmina* funds) are generated primarily from charges paid for the economic use of environmental resources. Principles of collection, distribution of collected revenue among various funds and the possible purposes of their expenditure are defined by the Environmental Protection Law[7], as well as by the internal roles of particular funds established by their boards of management. The environmental funds provide financial support to environmental protection activities on preferential terms, most often in the form of low interest loans and grants. In cases when the project is completed as expected by the loan agreement and the borrower attains the planned environmental effects, the loan may partly be waved.

Preferential financing of environmental protection activities is the main objective of operations performed by some ecologic foundations. They do manage funds provided by trustees (these funds may be also supplemented by the revenues gained in result of commercial activities of such foundations). A good example is the EcoFund Foundation, established in 1992 by the Minister of Finance, for effective management of financial resources obtained from the swap of part of the Polish foreign debt into an instrument of environmental protection (known as "debt eco-conversion"). So far USA, France, Switzerland, Italy, Sweden and Norway decided to convert part of the Polish debt into environmental protection support resources (571 million USD in total, in 1992–2010).

The task of the EcoFund Foundation is to co-finance such environmental protection activities, which not only are significant for the region or country but have an impact upon attaining environmental objectives regarded as priority goals by the international community of the European or even global scale. Another task of the Foundation is to facilitate the transfer of the best available technologies to the Polish market from the donating countries as well as to stimulate the development of domestic environmental protection industry.

Five environmental protection sectors have been recognised as priority areas, namely:

1. Reduction of trans-border transportation of sulphur dioxide and nitrogen oxides and elimination of low emission sources including, among others:
   - Elimination of sulphur from fuels and upgrading fuels before distribution;
   - Change in coal combustion and power production technologies;
   - Introduction of fuels, less polluting the environment;
   - Promotion of the best technologies for pollution emission reduction.
2. Reduction of pollution discharge into the Baltic Sea and protection of water resources, including:
   - Reduction of pollution run-off from cropland, meadows and roads into surface waters;
   - Protection of lakes, most valuable in terms of nature conservation, against pollution;
   - Protection of water intakes, including protection of the main underground water reservoirs against infiltration of surface waters polluted with wastewater.
3. Reduction of greenhouse gases causing global climate change. The EcoFund supports implementation of projects connected primarily with energy saving and improvement of energy use efficiency and promotes use of renewable energy sources.
4. Protection of biological diversity.
5. Waste management and reclamation of polluted soils, including among others:
   - Development of complex systems of selective collection, recycling and reuse of hazardous waste and municipal waste management systems serving 50–250 dwellers;
   - Measures linked to elimination of hazardous waste generation in industrial processes and elimination of such waste;
   - Clean up of soils contaminated by hazardous waste presenting a threat to human beings and nature.

Some banks offer financial support for environmental protection activities either on preferential or commercial terms. A particular position among them holds the Bank Ochrony Środowiska (Environmental Protection Bank), providing loans at low interest rates (subsidized by the National Fund for Environmental Protection and Water Management), and other banks offering loans to support agriculture and development of rural infrastructure.

Activities aimed at environmental protection may be, according to legal regulations, subsidized in the following manners:

- *Waiver of the income tax from individuals and legal bodies* on part of the income gained in result of commercial activities, in which waste material generated on the Polish territory was used;
- *Waiver of the income tax from legal bodies* on income from sale of real assets or rights of perpetual use of properties based on environmental protection regulations as well as tax payers' income (except for state enterprises, co-operatives, companies, municipal enterprises and budget entities), which statutory objective of activities is environmental protection;
- *Waiver of the VAT tax or reduction of the VAT tax rate* of some types of services connected with environmental protection;
- Opportunity to *deduct*, under specific terms, *from the taxable income of capital expenditures* connected with activities concerning collection, purchase and segregation of waste;
- *Deduction from the taxable income* of legal bodies donations for environmental protection purposes, not exceeding 10% of the total income;
- *Relaxation in the farm land tax* eligible on the ground of expenditures made for the construction or modernisation of environmental protection installations;
- *Waiver of the real estate tax* on land appropriated for buildings serving as wastewater treatment or disposal facilities;
- *Financial support of regional development* from the state budget resources, which can be appropriated for the tasks included in the voivodeship contracts; such tasks include also capital expenditures improving the quality of the environment.

8. MINISTRIES, AGENCIES AND OTHER SUPERVISION AND CONTROL INSTITUTIONS

As shown by the review of the legal system presented in Chapter 7, the responsibility for the implementation of particular legal requirements is imposed by the Council of Ministers on several ministries and governmental agencies. The general system of supervision and control of persistent organic pollutants in Poland is shown in the Diagram 8.1. In result of harmonization of the Polish law and the organisational

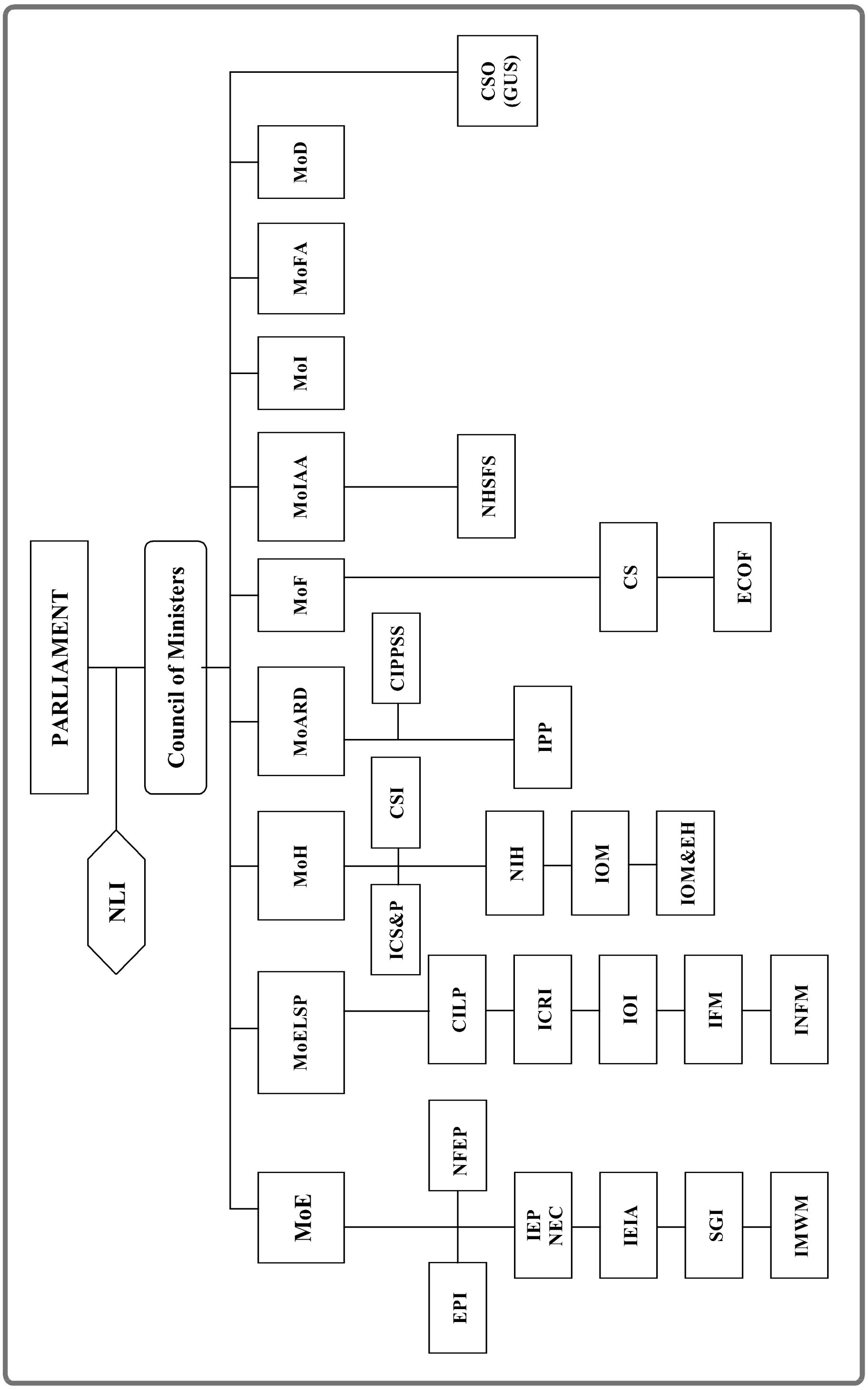


Diagram 8.1. Scheme of supervision and control of persistent organic pollutants

structures with the requirements of the European Union, the set up and scope of responsibilities of the state administration bodies undergo minor changes. Information presented under this chapter reflects the legal status as of 1 July 2003.

The principle burden of implementation and co-ordination of environmental protection tasks is resting on the **Minister of the Environment (MoE)**, who is responsible for the supervision and preparation of activities aiming at implementation of the Stockholm Convention provisions in Poland. The specific departments of the Ministry of the Environment execute these tasks as follows:

- Department of Ecological Policy (DEP) is responsible for the overall co-ordination of POPs related policy and all issues concerning waste and air pollution, among others, by persistent organic pollutants;
- Department of International Co-operation (DIC) is responsible for the representation of Poland on the international forum and participation in negotiations by implementing decisions given in negotiation instructions and presentation of reports on implementation of approved obligations;
- Department of Water Resources (DWR) is responsible for issues concerning water pollution, including wastewater and bottom sediments;
- Department of Environmental Protection Instruments (DEPI) co-ordinates activities aimed at implementation of the best available environmental technologies; performs general supervision over implementation of environmental development projects and is responsible for preparing proposals of environmental quality standards and principles of its monitoring.

The **Minister of the Environment** (in co-operation with other cabinet ministers) initiates and conducts legislative activities on the subject matter and supervises the law enforcement. The implementation of decisions made is controlled by the **Environmental Protection Inspection (EPI)** – Chief Inspectorate for Environmental Protection and Voivodeship Environmental Protection Inspections reporting to the voivodes within the framework of comprehensive territorial administrations. The tasks of the Inspection include control of compliance with the legal regulations and administrative decisions concerning the use of the environment (including inspection of industrial enterprises), monitoring and assessment of the state of the environment (within the scheme of the state environmental monitoring and upgrading procedures and methods in this area, including POPs).

Financial support for environmental activities is provided by the **National Fund for Environmental Protection and Water Management (NFEP)** together with the voivodship, *poviat* and *gmina* environmental funds, which are financing research and development projects, inquiries and capital development projects connected with reduction and disposal of POPs.

The **State Environmental Protection Council (SEPC)** plays the opinion making and counselling role to the Minister of the Environment and the research back up is provided by the scientific and research institutes subordinated to the Minister. Institutions belonging to the environmental sector and reporting to the Minister of the Environment are involved in the implementation of the Stockholm Convention. Among them, the **Institute of Environmental Protection (IEP)** is leading with the **National Stockholm Convention Focal Point (SCFP)**. The **National Emission Centre (NEC)** operates within the structure of the IEP with the task of collecting data on the 12 substances, subject to the Stockholm Convention. The Institute is also involved in preparing official reports about environmental impacts of plant protection chemicals. Inventory activities concerning PCB content in soil and underground water as well as on inventory and clean up of contaminated grounds in Poland are performed by the **State Geological Institute (SGI)** in Warsaw. Moreover, the **Institute for Ecology of Industrialized Areas (IEIA)** in Katowice is conducting research on POPs air emissions and the **Maritime Branch of the Institute for Meteorology and Water Management (IMWM-MB)** has been since mid 90s engaged in measurement of POPs concentrations in river waters, bottom sediments and aquatic organisms.

The **Minister of Economy, Labour and Social Policy (MoELSP)** is responsible for creating improved conditions for economic development, including functioning of economic entities, and improvement of labour conditions. The latter is linked to elimination of adverse effects of hazardous substances, including POPs, from the working environment. The Minister is also responsible for actions related to registration and marking of installations containing PCBs, development of decontamination plans, collection and registration of equipment for that purpose as well as for feasibility studies connected with the creation of a national technical capacity to decontaminate the equipment and treatment of PCBs. This sector co-operates with the National Emission Centre participating in the evaluation of POPs emission from the industry.

The task of the **Central Institute for Labour Protection (CILP)** is to conduct research concerning impact of harmful factors, including POPs on humans at their workplace. Research and development on process safety in the chemical industry, emission of POPs and the content of POPs in products are domains of the **Industrial Chemistry Research Institute (ICRI)**. The **Institute of Organic Industry (IOI)** is involved in research and development activities on synthesis of plant protection chemicals, chemical safety, transportation of hazardous materials and chemical plant protection preparations. Methods of investigation and technologies for treatment of waste generated by the metallurgical industry are dealt with by the **Institute of Ferrous Metallurgy (IFM)**, so as with research on emission of hazardous substances from smelting and combustion processes in the ferrous metallurgy. The **Institute**

of Non-Ferrous Metals (INFM) performs research activities concerning emission of hazardous substances including POPs from metallurgy and processing of non-ferrous metals.

The **Minister of Health (MoH)** co-ordinates issues aimed at ensuring human health protection, including problems connected with the influence of POPs on human health. The following agencies are executing these tasks:

- **Chief Sanitary Inspector (CSI)**, whose task is to exercise the general supervision of the country sanitary state (including POPs in foodstuffs, cleaning agents and other products);
- **Inspector for Chemical Substances and Preparations (ICS&P)** who keeps a register of chemical substances and preparations (except for pesticides and medicines) introduced for marketing (produced or imported);

Additionally, a number of research and development centres are supporting the Minister of Health, e.g. the **National Institute of Hygiene (NIH)** in Warsaw conducts research work on the human exposure to different POPs levels in the environment and on relevant risk assessment. The Institute also plays an important advisory role to the health sector on effects of POPs influence on human organisms. Two other centres – the **Institute of Occupational Medicine (IOM)** and the **Institute of Occupational Medicine and Environmental Health (IOM&EH)** – are conducting research work concerning hazards to human beings posed by environmental pollutions, particularly in the industrialized areas.

The **Minister of Agriculture and Rural Development (MoARD)** is responsible for the governmental policy concerning agriculture (including plant protection chemicals). The **Chief Inspector for Plant Protection and Seed Service (CIPP)** has the task to supervise and control, among others, the regularity of marketing and use of pesticides. The duty of registration of plant protection chemicals introduced on the market (produced and imported) belongs to the **Bureau for Registration of Plant Protection Chemicals** located within the **Institute of Plant Protection (IPP)** in Poznań. The latter is the leading centre for research and development activities concerning disposal of pesticide residues (including removal and cleaning up pesticide landfills).

The **Minister of Foreign Affairs (MoFA)** is co-ordinating international co-operation, including negotiations of multilateral agreements and is responsible for piloting their ratification procedures. He is also entrusted with the position of the political co-ordinator of the GEF activities in Poland.

Establishment of the **Polish Steering Committee for the Global Environment Facility** was initiated by the sector of foreign affairs in order to initiate strategic and programme consultations (determination of priority areas of co-operation with the GEF) and evaluate proposals of large projects proposed to the Global Environmental Facility.

The **EcoFund Foundation (ECOF)** has been entrusted with the function of an organisational GEF focal point. Operational support of GEF activities in Poland, related to medium and large projects is one of its tasks.

The fundamental task of the **Customs Service (CS)** is, apart from collection of custom duties, the customs control of goods turnover with foreign countries, combat the contraband and prevent customs fraud. The Custom Service performs also the control functions concerning compliance with national and international regulations related to restrictions and bans in goods turnover with foreign countries and also, on instruments of the national customs policy regulating the directions and volume of goods turnover with foreign countries (for instance, monitoring on implementation of customs quota).

The **Minister of Internal Affairs and Administration (MoIAA)** co-ordinates activities aimed at the improvement of security through precaution measures implemented by the respective subordinated services. The **National Headquarters of the State Fire Service (NHSFS)** is responsible for actions of the fire brigades within the National Fire and Rescue System on control, investigations and rescues (in cases of fire, accident and damage with the presence of hazardous substances or waste).

The **Minister of Infrastructure (MoI)** is in charge, with a due regard to the National Environmental Policy, of the communal and transportation sectors and undertakes legislative initiatives aimed, among others, at safe transportation of hazardous materials.

Results of statistical data, as being collected and maintained within the system of public statistics, are made accessible by the **Central Statistical Office (CSO – GUS)** (countrywide data) and the voivodeship statistical offices (regional data). Information concerning environmental protection has been presented since 1972 in the form of GUS publication series "Ochrona środowiska" (Environmental Protection). Statistical data concerning persistent organic pollutants, does not cover all the POPs subject to the Stockholm Convention.

The **National Labour Inspection (NLI)** has been established to supervise and control compliance with the occupational law, specifically with regulations and principles of labour safety and hygiene. Control activities are extended over all enterprises, including facilities applying hazardous substances. This Inspection is reporting directly to the Parliament.

The list of institutions and organizations involved in POPs issues in Poland is contained in Annex 6.

9. TECHNICAL CAPABILITIES OF COMPANIES INVOLVED IN HANDLING POPs AND INTERNATIONAL COOPERATION

9.1. ELIMINATION OF PESTICIDE STOCKS AND LANDFILLS

In 1999 activities aimed at elimination of pesticide landfills in 5 voivodeships (Kujawsko-Pomorskie, Lubelskie, Łódzkie, Mazowieckie and Świętokrzyskie) were initiated. The voivodeship administration, heads of districts (*poviats*) and heads of municipalities (*gminas*) are responsible for removal of pesticide landfills. In 1999 three such landfills were liquidated: in Biskupice (*gmina* Trawniki, Lubelskie voivodeship), Dratów (*gmina* Lublin, Lubelskie voivodeship) and Suskowola (*gmina* Pionki, Mazowieckie voivodeship). The pesticide landfills in Annopol, Lubelskie voivodeship and Wąsocz, Podlaskie voivodeship are under liquidation now. The pesticides from Biskupice, Dratów, Annopol and Wąsocz were exported for incineration to Germany and Holland. Pesticides from the Suskowola pesticide landfill in Mazowieckie voivodeship were deposited at their owner's storage facilities. From the pesticide landfill Żabice, *gmina* Górzyca, Lubelskie voivodeship, about 100 tonnes of pesticides were sent for incineration to Germany, while about 18 tonnes of chemicals, i.e. reagents and medicines are still remaining on site. Details about the liquidation of pesticide landfills during 2000 to 2002 are presented in Table 9.1.

According to the guidelines of the 2nd National Environmental Policy, the deadline for elimination of the existing dumps and pesticide landfills comprising of outdated pesticides foreseen by the National Waste Management Plan has been set for the year 2010.

Table 9.1. Specification of eliminated pesticide landfills during 2000–2002

Year	Location	Amount of waste dumped [tonnes]	Comments
2000	Stolno	73.6	Incinerated abroad
2000	Tworzymirki – Gaj	n.a.	Incinerated abroad, contaminated ground landfilled
2001	Cierpiszewo	n.a.	Incinerated abroad
2001	Porzydów	n.a.	Incinerated abroad
2001	Kiełpin	n.a.	Incinerated abroad
2001	Kieciszew	116 m^3	Incinerated abroad
2002	Linie	70	Incinerated abroad

n.a. – Data not available.

Doing away with the past legacy in pesticide management resulting in stockpiles of pesticide wastes should be treated separately from the current requirements in this respect. The market supply of pesticides in 2000 was 22 164 tonnes. Due to high prices only small amounts of pesticides become outdated, but packaging waste remains. The estimated amount of packaging mass per 1 kg of pesticides is equal to 55.25 g, thus a total of 1 224.5 tonnes of such waste is generated country-wide. Most of them find their way into the municipal solid-waste disposal system. According to the Packaging and Packaging Waste Law[22] producers are obliged to collect, at their own expense, returnable packaging and packaging waste. This should lead to isolation of this kind of waste from the stream of municipal waste. The packaging collecting system should be based on the goods' distribution network.

All pesticide landfills should be removed. Priority in liquidation should be given to objects located in unfavourable geological conditions, thus strongly polluting the aquatic and ground environment. In the process of liquidation and reclamation of pesticide landfills, other hazardous wastes are generated (contaminated ground and concrete from silos). The mass of these wastes is usually four times of the quantity of removed outdated pesticides. Hence, about 60 000 tonnes of these wastes will need to be deposited on hazardous waste landfills.

About 45 pesticide landfills have been completely recultivated since 1999. About 4500 tonnes of outdated plant protection chemicals were thermally treated. Incineration took place in Dutch and German incinerators.

Liquidation and reclamation activities are carried out in Poland by four enterprises, furnished with adequate permits, as required by the Waste Law. Depending on demand, Poland has the potential to increase the number and processing capacities of entities able to perform activities connected with extraction, packing and transportation of pesticide wastes, POPs contaminated debris from demolished silos and surrounding earth. This kind of enterprises are recruited from among subsidiaries of construction companies, which, after minor supplements of equipment and training of personnel, may be prepared to undertake execution of this type of work.

The number of cleaned-up pesticide landfills is limited only by the shortage of financing. The majority of liquidation projects have been financed so far by the National Fund and the Voivodeship Funds for Environmental Protection and Water Management. Undoubtedly, it is very urgent to finalise activities on preparation of a succession list of pesticide landfills for liquidation, as discussed in Chapter 3.

It is necessary to develop framework guidelines for the clean up of pesticide landfills, with a definition of criteria for classification of contaminated construction

[22] Dz.U. 2001, No. 63, item 638; as amended.

debris waste and ground as well as basic principles of handling the extraction, packaging, storage and transportation of pesticide waste, debris waste and contaminated soil. Assuming that the period of clean-up activities may last for 6 years, the average[23] annual scope of work would include 2 500 tonnes of plant protection chemicals and 10 000 tonnes of construction debris waste and ground· Hence, the average capacities, required to implement the outdated pesticides liquidation task, would be the following:

1. Extraction, storage and transportation of pesticide waste 2500 tonnes/year;
2. Demolition work and extraction of contaminated soil 10 000 tonnes/year;
3. Dumping of debris and soil on hazardous waste landfills 10 000 m^3: 1.4 = = 7000 m^3/year;
4. Decontamination (disintegration, irreversible transformation) 2500 tonnes/year;
5. Pesticide landfill site reclamation area – estimate 8 ha/year.

The requirements listed above relate to the implementation of the programme aimed at elimination of remnants of the past in respect of liquidation of outdated pesticides and the clean-up capacities will be superfluous after its completion. This supports the idea of encouraging the construction back-up enterprises to participate in the implementation of this programme. They could detach a relatively minor part of their capacity for the requirements of the programme and easily return to their normal activities after the task is completed.

So far, the liquidation of pesticide landfills has been connected with thermal destruction of pesticides in foreign incinerators. Currently, hazardous waste incinerators exist and operate also in Poland. They are technically prepared to handle POPs in a manner safe to the environment, like for instance the hazardous waste incinerator of the ANWIL Nitrogen Plant in Włocławek, or the hazardous waste incinerator of the ROKITA Chemical Works in Brzeg Dolny. Installation for pesticide waste incineration at the Sośnicowice Branch of the Plant Protection Institute is waiting to be assembled and run in. According to the National Waste Management Plan the expected total processing capacity of hazardous waste incineration facilities in Poland is as follows:

- 127 000 tonnes in 2003;
- 139 000 tonnes in 2006;
- 152 000 tonnes in 2012.

The hazardous waste incineration installations existing in Poland, including the new incinerator, foreseen by the National Waste Management Plan, will be able to accept for decontamination all the pesticide waste from pesticide landfills being cleaned up.

[23] According to estimates adopted by the National Waste Management Plan.

However, the issue of satisfying the needs for land filling of 10 000 tonnes of contaminated debris and soil looks different. At present, it is difficult to decide, without an adequate feasibility study, whether the concept of dumping all these waste on landfills is the proper solution, particularly because the main costs of such a solution are connected with transport. It seems necessary to review the opportunities for decontamination *in situ,* at least the soil masses.

Since the flow of wastes, connected with the current use of plant protection chemicals and their packages, is relatively limited (in the coming years it will be maximum at 1200 tonnes/year) there is no need for further development of capacities concerning elimination of these wastes. Contemporary plant protection chemicals and their packages can be destroyed by the classical hazardous waste incineration facilities. The suitability of decontamination methods for packages other than thermal must also be taken into consideration.

9.2. ELIMINATION OF PCB-CONTAINING WASTE

There are installations for treatment of PCB-containing waste by thermal methods in Poland. These are the facilities mentioned under item 9.1 (hazardous waste incinerators). It can be assumed, like in the case of plant protection chemicals, that the processing capacity of these installations is satisfactory and there is no need to build special incinerators for waste containing PCBs.

Decontamination consisting of removal of PCB from equipment previously containing PCBs requires adequate installations to be used. The capacity of the existing installation[24] for recuperation of hydrogen chloride from chloroorganic waste compounds, operated by ANWIL Company in Włocławek is 400 to 500 tonnes/year[25]. Considering the mass of transformers to be decontaminated, as quoted in Point 3.4 of Chapter 3, an increase of that capacity to 800–1000 tonnes/year, will be necessary. Nevertheless, no facility for decontamination of low-dimension electric equipment (mainly capacitors), drained of PCB containing agents is available in Poland. It is necessary to set working such a facility in Poland or to ensure access to an adequate installation abroad.

Poland is also lacking installations for thermal destruction of solid hazardous waste containing chloroorganic substances or capabilities to treat such waste using other methods, for instance by disposing them of in rock salt excavations. It does not, however, seem appropriate to tackle the problem of PCBs in solid wastes, since the opportunities for their collection are very small.

[24] Organization of logistic action and analytical control of waste received is performed by the „Chemeko" Co. Ltd. providing in specialized services.
[25] 50 transformers will be destructed and 200 transformers will be used further.

The cost of decontamination of 1 tonne of PCB-containing oils, including transport expenditures, is at present at the level of 17 000 PLN (4250 EUR)[26] and for 1 tonne of capacitors respectively 20 000 PLN (5000 EUR). Decontamination costs of equipment is estimated by the National Waste Management Plan at about 6000 PLN/tonne (1500 EUR/tonne). These costs are supposed to be covered by the users of such equipment. However, since among the users there were also enterprises either under winding up or sold out, other sources of financing must also be taken into account (e.g. state or local government budgets).

Results of the preliminary review indicate that at present there is no technology other than the thermal one for destruction of POPs on the Polish market.

10. ENVIRONMENTAL MONITORING AND SCIENTIFIC RESEARCH POTENTIAL

10.1. ENVIRONMENTAL MONITORING SYSTEM IN POLAND

Tasks. According to the Law on Environmental Protection Inspection[17] the State Environmental Monitoring (SEM) is a system of measurements, evaluations and forecasting of the state of environment, implemented by the organisational units of the state administration and government bodies, organs of *gminas* as well as by higher education establishments and economic entities. SEM is implemented on the basis of multi-annual programs endorsed by the management of the Ministry of the Environment. The objective of the SEM is enhancement of efficiency of environmental protection activities through collection, analyses and making available the information on the state of environment and environmental changes taking place.

The basic task of the State Environmental Monitoring is to provide information on:
- The current state and the degree of pollution of specific elements of the environment;
- Loads of pollutants diverted to the environment;
- Dynamics of anthropogenic changes in the natural environment;
- Predicted effects of use of the environment.

The system of SEM must provide for the implementation of obligations resulting from international conventions signed by Poland and should take into account regulations and guidelines valid in this respect in the EU countries. This is one of the factors allowing for the comparison of results obtained in various European countries. In this respect, the Monitoring Department of the Chief Inspectorate for Environmental Protection plays the role of the national focal contact centre for the

[26] The rate 1 EUR = 4 PLN was used in calculations.

co-operation with the European Environmental Agency (EEA) and co-ordinates operations of the European Information and Observation Network (EIONET) branch established in Poland by the EEA.

Organizational structure and scope of research. The State Environmental Monitoring in Poland is functioning through the countrywide, regional and local network of stations and measurement posts.

The countrywide network of stations and measurement posts includes:
- Stations for early detection of radioactive contamination;
- Stations working in accordance with international programs, for instance EMEP and HELCOM;
- Stations measuring environmental pollution along state borders and border zones;
- Stations measuring environmental pollution in terms of the National Environmental Policy implementation efficacy and efficiency;
- Stations reflecting the functioning of ecosystems typical to Poland.

The SEM system has been sub-divided into three blocks: (a) environmental quality, (b) emission and (c) evaluations and forecasts. The first two blocks are designated for information gathering. Laboratories of the Voivodeship Environmental Protection Inspectorates carry out most of these measurements. The task of the air monitoring subsystem is to supply information required to undertake activities aimed at reduction of pollution, to evaluate the efficiency of such activities as well as to assess hazard to human health, natural ecosystems and technical objects from air pollutants.

Within the air monitoring sub-system, data on the concentration of selected pollutants in air and atmospheric precipitation at different space and time scales and allowing investigation of phenomena of global character are obtained and analysed. It includes, for example, the following tasks:
- Testing and evaluation of atmospheric air quality (identification of areas with exceeded air standard values, analyses of trends);
- Studies of the chemical mechanism of atmospheric precipitation and deposition of pollutants on the surface;
- Studies of the air pollution background according to EMEP, GAW/WMO programmes.

The block: “emissions” gathers emission data within the framework of three subsystems:
- Sub-system “air” includes information on measurements of the basic air pollutants, excluding POPs;
- Sub-system “water”, provides, among others, information about the results of quality tests of sea, surface and underground waters, contamination of fish and the balance of pollution loads at bench-mark river cross-sections, which are subject to the Stockholm Convention: dieldrin, DDT total, PCB total and HCB;

- Sub-system "waste" gathers information on quantities of generated waste, landfills registration and turnover of hazardous waste.

The "evaluations and forecasts" block is based on data obtained within the first two blocks; it is expected to enable the preparation of integrated evaluations and forecasts of environmental quality.

Pursuant to Article 25, paragraph 2 of the Law on Environmental Protection Inspection, laboratories and other organisational units involved in measurements of environmental quality and operating within the system of the SEM should comply with the uniform requirements set up by the Minister of the Environment and obtain a certificate of the Environmental Protection Inspection. According to the assumptions of the programme on the state environmental monitoring system, the reliability of the SEM will be guaranteed by the continuation and upgrading of the testing quality control system and measurements, and particularly through accreditation of testing laboratories, domestic and international comparative tests, development and implementation of quality systems in the SEM sub-systems.

10.2. POPs MEASUREMENT CAPACITIES OF ANALYTICAL LABORATORIES

In order to identify the monitoring capacities concerning persistent organic pollutants within the framework of the GF/POL/01/004 Project, 69 laboratories were assessed – mainly belonging to the voivodeship Sanitary and Epidemiological Stations (WSSE), voivodeship Environmental Protection Inspectorates (WIOŚ) and universities – for their abilities to test substances covered by the Stockholm Convention and for their preparedness to undergo inter-laboratory tests of substances indicated by themselves in selected environmental media (air, water, waste, food, living organisms, plants, food products and human body).

Table 10.1 presents the number of laboratories in Poland determining POPs in specific media. However, detailed information is provided in Annex 3 (results of inquiry) and in Annex 4 (characteristics of 4 laboratories with the largest potential in POPs determination). Based on the results obtained, the preliminary description of the emission and concentration monitoring potential concerning POPs mentioned above has been formulated:

a) Five laboratories (WIOŚ Lublin, Kraków University of Technology, Institute of Meteorology and Water Management, Gdańsk Branch, Military Institute of Chemistry and Radiometry, National Foundation of Environmental Protection in Warsaw) are performing the widest scope of tests, including all environmental media for three major groups of substances (PCBs, HCB, dioxins and furans) and are

Table 10.1. Number of laboratories offering tests of POPs in specific media in Poland

Persistent organic pollutants	Media								
	Air	Water		Solid waste, incl. sewage sludge and ashes	Bottom sediments	Living organisms	Plants	Food products	Human body (human milk, blood etc.)
		Potable	Surface, underground, sea						
Aldrin	6	16	19	9	10	4	7	13	7
Chlordane	6	10	14	7	8	4	6	7	5
Dieldrin	6	16	19	10	11	4	8	14	7
Endrin	5	13	16	8	9	4	7	10	5
Heptachlor	6	16	18	9	10	5	8	15	7
Hexachlorobenzene	7	18	20	12	12	6	9	17	9
Mirex	4	6	10	5	6	3	5	6	4
Toxaphene	5	7	10	5	6	2	4	5	4
PCBs	9	19	28	15	16	7	9	13	9
DDT	8	23	27	10	14	5	8	19	10
PCDDs/PCDFs	5	5	5	5	5	4	4	5	5

prepared to submit to inter-laboratory tests. Only these laboratories carry out dioxin and furan measurements;

b) Majority of WIOŚ laboratories (12 out of 17) conduct the tests only for water and only within a limited scope – mainly PCBs and DDT. Within this group the widest range of measurements is offered by WIOŚ Olsztyn together with its branch in Elbląg, WIOŚ Poznań and WIOŚ Szczecin;
c) Seven laboratories belonging to WSSE offer testing almost exclusively in water and food products, primarily for aldrin, HCB and DDT. The widest scope of measurements is available from WSSE Warsaw and WSSE Poznań.
d) From among three laboratories of the Institute of Meteorology and Water Management (IMWM), two (IMWM Wrocław and IMWM Warsaw) conduct only the measurements of PCBs and DDT. The third laboratory, IMWM Gdańsk offers full range of tests and was mentioned under item a);
e) The remaining group consists of 11 laboratories of research institutes and universities not mentioned above. Three of them (Institute of Chemical Carbon Processing, Institute of Environmental Protection and the Institute of Marine Fisheries in Gdynia) perform a very limited scope of measurements. The remaining centres are making tests in various media for the majority of the substances in question, usually depending on the sector's character.

Inter-laboratory comparison tests. Among laboratories which expressed their readiness to undergo inter-laboratory tests, eight have been selected for the actual check.

Inter-laboratory tests concerning PCDDs, PCDFs, PCBs and HCB were carried out in November and December 2002. These tests were based on determination of the above compounds in a sample of ashes taken from a hazardous waste incineration plant, prepared by the Team of Trace Analyses Laboratory of the Kraków University of Technology in co-operation with the University of Umea in Sweden. The subject of determination included 17 congeners of the PCDDs/PCDFs, 3 congeners of PPCB: PCB77, PCB126 and PCB169 and HCB in a 10g sample of ash.

Results of the performed tests were submitted by four laboratories: Trace Analyses Laboratory, Institute C-1 of the Kraków University of Technology, Military Institute of Chemistry and Radiometry, Institute of Pulp and Paper and the Laboratory of the National Foundation of Environmental Protection.

The results of comparisons indicate that practically three laboratories determined correctly the content of PCCDs and PCDFs and two of PCBs and HCB.

Inter-laboratory comparisons concerning determination of PCDDs/PCDFs, PCBs and HCB should be continued in the following years.

10.3. RESEARCH AND DEVELOPMENT CAPACITY ON POPs ISSUES, SUBJECT TO THE STOCKHOLM CONVENTION, IN POLAND

10.3.1. Introductory information

The research and development capacity concerning persistent organic pollutants, being subject to the Stockholm Convention, is concentrated in a number of centres specialised in research on POPs. In order to assess that capacity, a review of the following issues was carried out:

- Scientific and research projects financed by the State Committee for Scientific Research;
- Papers published by Polish authors in Polish and English;
- Subjects of conferences of the "Dioxins in industry and environment" cycle.

Databases found on websites, related to the above listed issues, were subject of the review. The scope of research activities concerning POPs is very wide and includes various aspects of their presence in the environment. Many universities and research centres are tackling these problems. Depending on the profile of specific institutions, activities are focused on the following issues:

- Development of measurement methods;
- Laboratory tests of POPs content in samples of different origin;
- Field measurements of POPs air emissions;
- Study of chemical processes of POPs origination and neutralisation (methods, technologies);
- Analyses of POPs environmental migration and accumulation processes;
- Study of POPs effects on living organisms (laboratory tests, experiments on animals).

10.3.2. Scientific and research activities financed by the State Committee for Scientific Research

The State Committee for Scientific Research financed a considerable number of projects concerning POPs. For instance: in 1996 one project financed by that Committee was completed, in the years 1998 and 1999 three projects each year, in 2000 six and in 2001 seven such projects were finalized. Below (Table 10.2) a list of institutions involved in execution of scientific research projects dealing with dioxins and polychlorinated biphenyls, is given.

The database providing information about projects financed by the State Committee for Scientific Research using the key words "dioxins", "polychlorinated biphenyls" and "pesticides" in titles of research projects was reviewed.

Table 10.2. Institutions carrying out scientific and research projects concerning dioxins and polychlorinated biphenyls

Research institution
Karol Marcinkowski Medical University in Poznań; Faculty of Pharmacy, Chair and Section of Inorganic and Analytical Chemistry
Medical University in Lublin; Faculty of Medicine; Chair and Section of Pharmacology
Institute of Meteorology and Water Management, Gdynia Branch
Institute of Basics of Environmental Engineering, Polish Academy of Sciences, Zabrze
State Institute of Veterinary Science
Częstochowa University of Technology, Faculty of Construction and Environmental Engineering, and the Department of Engineering and Environmental Protection, Institute of Environmental Engineering
Gdańsk University of Technology; Faculty of Chemistry; Section of Analytical Chemistry and the Chair Chemical Technology
Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Łódź University of Technology; Faculty of Food Chemistry and Biotechnology
Wrocław University of Technology; Faculty of Chemistry; Institute of Petroleum and Coal Chemistry and Technology
Gdańsk University; Faculty of Chemistry
Adam Mickiewicz Poznań University; Faculty of Biology
Jagiellonian University in Kraków; Faculty of Biology and Earth Sciences; Institute of Zoology; Faculty of Chemistry

The list of the projects completed under the above-mentioned categories is presented in Table 10.3. Under the category of "dioxins" most of them dealt with the methods of POPs determination in various kinds of environmental samples (food products, soil and bottom sediments, samples of wastewater and municipal waste, surface and underground water and biological material) and the methods of dioxins and furans' air emission measurements. The remaining three subjects were related to dioxin effect on biological processes.

Studies within the category of "polychlorinated biphenyls" concerned, among others, the methods of PCB determination in samples of different origin, assessment of PCB pollution in ecosystems, extraction of PCBs from wastewater sludge and the methods of PCB degradation in oil waste. In one of the projects an attempt was made to assess the quantity of PCBs in Poland including inventory of electric energy installations (capacitors and transformers).

Table 10.3. List of the grants of the State Committee for Scientific Research

Scientific and research projects	Period of performance	Project Manager	Executing agency
1	2	3	4
Studies on determination of polychlorinated dibenzodioxins, dibenzofurans and biphenyls.	02.1997 – 02.2001	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Studies on dioxins' formation processes in the gaseous phase and development of their determination methods in samples of materials with multiple matrix.	10.1996 – 06.2001	Izabela Wiater-Protas	Jagiellonian University in Kraków, Faculty of Chemistry
Dioxins – assessment of hazards for man in Poland – preliminary studies.	02.1998 – 12.1998		
Function of the Ah receptor and the action mechanism of dioxins and related compounds.	12.1998 – 04.1999	Jadwiga Piskorska-Pliszczyńska	State Institute of Veterinary Science
Development of polychlorinated-p-dibenzodioxins, dibenzofurans determination methods in material of the food products type.	01.2000 – 12.2000	Ryszard Chrząszcz	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Studies on determination of dioxins in samples of wastewater and municipal waste and wastewater sludge.	09.2001 – 10.2001	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Influence of dioxins on creation of steroids by ovarian cells.	12.1998 – 06.2001	Renata Wołcz	Jagiellonian University in Kraków, Faculty of Biology and Earth Science
Measurements of dioxins and furans as well as other pollutants released into air from the cement furnace of the Cement Factory Rudniki S.A.	04.2001 – 05.2001	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology

1	2	3	4
Analytical work in support of scientific and research activities with use of equipment of the Institute of Inorganic Chemistry and Technology aimed at development of dioxins testing method in the geological environment (soils, water sediments, surface and underground waters) and in biological material.	06.2000 – 06.2000	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Studies on polychlorinated biphenyls in samples of organic origin.	01.2001 – 12.2001	Ryszard Chrząszcz	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Extraction and dynamic of bleaching of polychlorinated biphenyls from wastewater sludge.	01.1997 – 06.2000	Agata Rosińska	Czestochowa University of Technology, Facu-lty of Environmental Engineering and Protection, Institute of Environmental Engineering
Assessment of selected methods of polychlorinated biphenyls degradation in waste oil.	06.1998 – 09.2001	Elżbieta Sobiecka	Łódź University of Technology, Faculty of Food Chemistry and Biotechnology
Development of a determination method for coplanar chlorinated biphenyls' in soil and sediment samples with use of mass spectrometry of the MS/MS type.	01.2000 – 12.2000	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Development of a system preventing the natural environment in Poland to be contaminated by PCB compounds.	05.1995-04.1997	Marian Rutkowski	Wrocław University of Technology; Institute of Petroleum and Coal Chemistry
Determination of coplanar chlorinated biphenyls' in soil and sediment samples in the presence of chlorinated dibenzodioxins and dibenzofurans. Phase I.	01.1998 – 12.1998	Adam Grochowalski	Tadeusz Kościuszko Kraków University of Technology; Faculty of Chemical Engineering and Technology; Institute of Inorganic Chemistry and Technology
Polychlorinated biphenyls (PCB) in southern part of the Baltic Sea.	05.1997 – 12.2000	Adriana Dembowska	Gdańsk University; Faculty of Chemistry
Polychlorinated biphenyls in the environment.	03.1999 – 11.1999	Janina Lulek	Karol Marcinkowski Medical Academy in

1	2	3	4
Degradation of chloroorganic pesticides in the structure UV/T and O_2.	10.1995 – 07.2000	Adriana Zaleska	Gdańsk University of Technology, Faculty of Chemistry, Chair of Chemical Technology
Tremble causing and toxic effects of selected polychlorinated pesticides and synthetic pyretroids in mice. Influence of antagonists of stimulating amino acids.	10.1996 – 12.1997	Piotr Błaszczak	Medical University in Lublin, Faculty of Medicine, Chair and Section of Pharmacology
Photocatalytic detoxification of chloroorganic pesticides: comparison of efficiency in application of titanium dioxide in the form of suspension and the immobilised titanium dioxide at the surface of glass microspheres.	02.1998 – 01.1999	Adriana Zaleska	Gdańsk University of Technology, Faculty of Chemistry, Chair of Chemical Technology
Assessment of toxic composition of the Oder River environment.	01.2001 – 12.2001	Elżbieta Niemirycz	Institute for Meteorology and Water Management, Gdynia Branch in Gdynia
Polychlorinated biphenyls (PCB) as a factor disturbing endocrine processes in pigs ovary.	01.2000 – 12.2002	Anna Wójtowicz	Jagiellonian University in Kraków, Faculty of Biology and Earth Science; Institute of Zoology
Determination of content and analysis of polychlorinated biphenyls in solid waste and sludge (thesis).	06.1996 – 12.1998	Wiesław Sułkowski	Częstochowa University of Technology, Faculty of Construction and Environmental Engineering
Hydrodesulphurisation of mineral oils contaminated by polychlorinated biphenyls (PCBs).	01.2000 – 12.2001	Marek Stolarski	Wrocław University of Technology; Faculty of Chemistry; Institute of Petroleum and Coal Chemistry
Assessment of the level of residues of selected polychlorinated biphenyls (PCBs) in the Wielkopolska region population.	03.1999 – 02.2002	Janina Lulek	Karol Marcinkowski Medical Academy in Poznań, Pharmaceutical Faculty Chair and Section of Inorganic and Analytical Chemistry
Dioxins in municipal wastewater sludge as criteria of their non-industrial utilisation.	08.2001 – 07.2002	Sylwia Oleszek	Polish Academy of Sciences, Institute of Basics in Environmental Engineering, Zabrze
Studies on the effect of matrix on surface water samples preparation for determination of the organic compounds' content (thesis)	01.2000 – 12.2000	Jacek Namieśnik	Gdańsk University of Technology, Faculty of Chemistry, Chair of Chemical Technology
Polychlorinated biphenyls in the southern part of the Baltic Sea (thesis).	07.1999 – 06.2000	Jerzy Falandysz	Gdańsk University, Faculty of Chemistry

Research activities concerning the "pesticide" category were focussed on toxic effects, treatment of chloroorganic and polychlorinated pesticides and the assessment of the Oder River environmental toxic composition.

Interest on the issue of hexachlorobenzene was minimal and no projects in this respect were carried out.

10.3.3. Papers of Polish authors, concerning the Stockholm Convention published in Polish and English language periodicals

The database on Polish technical periodicals' topics concerning dioxins contains mainly publications in the following titles: *Chemia Analityczna, Ochrona Środowiska, Ekologia i Technika, Chemik.* Reports on similar subjects were also published in other periodicals, such as: *Ekoproblemy, Ekoprofit, Ochrona Powietrza i Problemy Odpadów* as well as in the *Roczniki PZH, Biuletyn WIChiR* and *Zeszyty Naukowe* (Scientific Publications) of some universities. A significant majority of scientific materials is published in the form of conference proceedings (domestic and international conferences and scientific symposia). Table 10.4 gives the list of these publications.

Review of Internet databases concerning scientific periodicals, on the basis of "Science Direct" database, does not allow for specifying all works of Polish authors concerning POPs. List of the identified publications has been compiled in Table 10.5.

Detailed information about persistent organic environmental pollutants can be found in technical literature. Issues concerned with environmental impacts of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans as well as related polychlorinated biphenyls, with the conditions, under which these compounds are created, with causes of their appearance in air, water, soil and food products, the methods of their elimination and the problems connected with biological activity of dioxins and furans are presented in the publication "Niebezpieczne dioksyny" *("Dangerous dioxins")* (Arkady Publishing Office, 2001). Another book "Pestycydy: występowanie, oznaczanie i unieszkodliwianie" *(Pesticides: occurrence, determination and treatment)* (Wydawnictwa Naukowo-Techniczne, 2001) provides information on:

- Methods of pesticide determination in different elements of the environment;
- Occurrence of pesticide waste, their collection and treatment with particular attention on issues concerning elimination of pesticide landfills.

Table 10.4. Papers of Polish authors in Polish periodicals

Author(s)	Paper title	Periodical
1	2	3
	Dioxins – assessment of the natural environmental hazards and methods of their detection.	EPI, *Biblioteka Monitoringu Środowiska*
Baranowska I., Pieszko C.	Analysis of pesticides by derivative spectrophotometry method	*Chemia Analityczna*, 2000, Vol. 45, No. 4, p. 583–593
Baranowska I., Pieszko C.	Derivative spectrophotometry in pesticide analysis.	*Zeszyty Naukowe. Chemia* / Politechnika Śląska, 1998, No. 137, p. 21–28
Biłyk A.	Occurrence of dioxins and furans in the environment	*Ochrona Środowiska*, 2000, Vol. 77, No. 2, p. 9–13
Dąbrowski Ł., Biziuk M., Gaca J.	Determination of selected environmental pollutions in samples of soil and bottom sediments with use of the GC-MS technique.	*Ekologia i Technika*, 1999, Vol. 7, No. 6, p. 185–191
Falandysz J.	Chloroorganic compounds in the environment. Health hazard.	*Roczniki PZH*, 1995, 47, p. 41–57
Falandysz J. et al.	Dioxins and furans in edible fish species of the Gdańsk Bay.	*Roczniki PZH*, 1996, 47, p. 197 – 204
Florek A.	Assessment of dioxin occurrence in the marine environment.	*Ekologia i Technika*, 2000, Vol. 8, No. 4, p. 100–108
Grabińska-Sota E., Kalka J., Wiśniowska E., Ścieranka B.	Impact of selected pesticides on the activity of activated sludge.	*Ochrona Środowiska*, 2000, Vol. 77, No. 2, p. 39–42
Grochowalski A.	Study on determination of polychlorinated dibenzodioxins, dibenzofurans and biphenyls.	*Seria Inżynieria i Technologia Chemiczna*, No. 272, University of Technology in Kraków, 2000
Grochowalski A.	Study on determination of polychlorinated dibenzodioxins, dibenzofurans and biphenyls.	*Zeszyty Naukowe* University of Technology in Kraków, 2000, ISSN 0860-097X
Grochowalski A. et al.	Slid phase extraction and capillary C-ECD analysis of PCDDs in chlorinated phenols.	*Chemia Analityczna*, 1993, 33, p. 279–286
Grochowalski A., Wiater I.	Carbon column as a clean-up method for oily samples purification for the determination of polychlorinated dibenzodioxins and dibenzofurans.	*Chemia Analityczna* 1998, 43, p. 399–408

1	2	3
Kobierski M.	Technology of pesticide wastewater purification on activated fly dust.	*Problemy Inżynierii Rolniczej*, 1998 (6), No. 1, p. 157–164
Makles Z.	Dioxins and incineration of solid waste.	*Biuletyn WIChiR,* 1997, 1(27), p. 29–46.
Nowakowski L., Budziarek M.	Dioxins – structure, physical and chemical characters and emission sources.	*Zeszyty Naukowe. Budownictwo* / Opole University of Technology, 1998, z. 1, p. 41–57
Pająk T.	Thermal processing of municipal waste as an element of contemporary comprehensive waste management.	*Przegląd Komunalny,* 1998 (78), p. 17–40
Pająk T.	Dioxins in the process of municipal waste incineration – hazards, standards, current situation, prevention.	*Roczniki PZH* 1996, 47, p. 105–119
Piecuch T.	Thermal waste processing and air protection against detrimental components of stack gases.	*Wydawnictwo Uczelniane Politechniki Koszalińskiej,* Koszalin 1998
Płaza G.	Dioxins – hazardous compounds.	*Ochrona Powietrza i Problemy Odpadów,* 1994, 28(2), p. 39–42
Skowron H.	Thermal processing of municipal waste – a must in the near future (4).	*Ekoproblemy,* 1998, 4, p. 14–18
Sokołowski M.	Dioxins – characters, sources and analytical problems	*Roczniki PZH* 1996, 47, p. 95–104
Ścigała R., Maślanka A	Fuel composition as a potential source of dioxins and furans emission.	*Chemik*, 2000, No. 4, p. 91–94
Wachowski L., Kirszensztejn P.	Dangerous dioxins and furans	*Ekoprofit,* 1999, 10(36), p. 44–48
Wandrasz J., Pikoń K.	Ability to absorb the imission of PCDDs/PCDFs compounds by man.	*Ekoproblemy,* 1996, 2, p. 10–11
Wandrasz J.W.	Management of hospital waste.	Polish Association of Sanitary Eng. and Technicians, *Oddział Wielkopolski,* Poznań 2000
Wiergowski M., Dąbrowski Ł., Galer K., Makuch B., Biziuk M.	Assessment of the Oder River basin waters by organic compounds after the flood in summer 1997. Part. I. Determination of pesticides and phenols in water and post flood sediments.	*Chemia Analityczna*, 2000, Vol. 45, No. 2, p. 181–190
Wiergowski M., Zaleska A., Biziuk M., Hupka J.	Comparison of three analytical procedures for determination of chloroorganic pesticides and their decomposition in water suspension during photo catalytic oxidation.	*Chemia Analityczna*, 2000, Vol. 45, No. 6, p. 901–910

Table 10.5. Papers of Polish authors published in foreign periodicals and Polish English-language journals

Author	Paper title	Periodical
Grochowalski A., Wybraniec S.	Levels of polychlorinated dibenzo-p-dioxins and dibenzofurans in flue gas and fly ash from coal combustion in a power plant.	*Fuel and Energy Abstracts,* Volume: 37, Issue: 5, September, 1996: 385
Grochowalski A.	PCDDs and PCDFs concentration in combustion gases and bottom ash from incineration of hospital wastes in Poland.	*Chemosphere,* Volume: 37, Issue: 9–12, October 11, 1998: 2279–2291
Grochowalski A., Chrząszcz R.	The Result of the Large Scale Determination of PCDDs, PCDFs and Coplanar PCBs in Polish Food Product Samples using GC-MS/MS Technique.	*Organohalogen Compounds*, 2000, 47: 306–310
Grochowalski, A., Chrząszcz R., Piekło R., Gregoraszczuk E.L.	Estrogenic and anti-estrogenic effect of in vitro treatment of follicular cells with 2,3,7,8-tetrachlorodibenzo-p-dioxin.	*Chemosphere,* Volume: 43, Issue: 4–7, May, 2001: 823–827
Grochowalski A., Chrząszcz R., Piekło R., Gregoraszczuk E.L	Estrogenic and anti-estrogenic effect of in vitro treatment of follicular cells with 2,3,7,8-tetrachlorodibenzo-p-dioxin.	*Chemosphere,* Volume: 43, Issue: 4–7, May, 2001: 823–827
Lulek J.	Levels of polychlorinated biphenyls in some waste motor and transformer oils from Poland.	*Chemosphere,* Volume: 37, Issue: 9–12, October 11, 1998: 2021–2030
Sułkowski W., Rosińska A.	Comparison of the efficiency of extraction methods for polychlorinated biphenyls from environmental wastes.	*Journal of Chromatography A,* Volume: 845, Issue: 1–2, June 11, 1999: 349–355
Grochowalski A., Chrząszcz R., Wybraniec S.	Detemination of PCDFs/PCDDs in ambient air from Cracow city, Poland.	*Organohalogen Compounds,* 1995, 21: 321–326
Grochowalski A. et al.	Determination of PCDDs in Polish Wood Conservants.	*Journal of Chromatography,* 1990, 502(1): 160–166
Grochowalski A. et al.	PCDD/F mass concentration in residues from incineration of medical wastes in Poland.	*Organohalogen Compounds,* 1996, 27: 42–46
Falandysz J., Szymczyk K.	Data on on the manufacture, use, inventory and disposal of polychlorinated biphenyls (PCBs) in Poland.	*Polish Journal of Environmental Studies,* Vol. 10, No. 3 (2001): 189–193

10.3.4. Cycle of conferences: „Dioxins in industry and environment"

The Kraków University of Technology and the EMPIRO Co. Ltd., are the organisers of a cycle of conferences devoted to „Dioxins in industry and environment". The subject matters discussed at the conferences are of a very wide range and cover the following topics of research:

- Methods for determination of pollution;
- Review of processes of POPs origin and sources of their releases;
- Methods of monitoring and emission reduction;
- Impact of POPs on the biological environment.

Also general reports, presenting evaluation of environmental emissions, POPs accumulation in specific elements of the environment, exposure to PCBs in Poland and legal issues are present. The conference's web sites are found under: **www.dioksyny.com.pl.**

Methods for determination of pollution. Studies on POPs determination methods are, among others, concerned with application of various types of special equipment or new methods and analyses of extraction and measurement of content of different investigated groups of compounds in various types of samples.

Review of processes of POPs formation and sources of their releases. Themes of papers concerning formation POPs processes and sources of their releases include:

- Review of POPs generation in industrial and technological processes and
- Review of POPs environmental accumulation and migration.

Methods of monitoring and emission reduction. Studies on measurements and emission reduction are mainly concerned with measuring methods and such aspects of manufacturing processes which can efficiently reduce POPs releases.

Impact of POPs on the biological environment. Investigations of POPs impact on environment are connected with:

- Studies of carcinogenic impact (nipple cancer) and disturbances of endocrine functions (follicular functions, men infertility);
- Studies on laboratory animals (influence of TCDD of reproduction in rats, pleura inflammation in rats, enzymatic activity in the erythrocytes of mice);
- Studies on POPs accumulation in living organisms and in the alimentary chain (Baltic fish, POPs in human milk).

11. NON-GOVERNMENTAL ORGANISATIONS AND PUBLIC PARTICIPATION

According to Article 10 of the Stockholm Convention, one of the significant elements, ensuring efficient protection of human health and environment against POPs is the extensive and conscious participation of the population in the implementation of actions undertaken in this respect. The above mentioned article recommends that the Parties to the Stockholm Convention, in addition to all other activities called for by the Convention shall, as much as circumstances allow, promote upgrading of awareness and skills as well as commitment of their citizens to perform activities concerning prevention of hazards caused by POPs, making an access to information easier and more extensive, preparing and implementation of educational programmes. Apart from that, direct involvement of public groups and their representatives in development of specific solutions and implementation of specific projects would be expected. Problems particularly significant for public participation in the implementation of Article 10 of the Convention include, among others, the following:
- Raising awareness of the policy and decision makers;
- Making public all kind of information which, according to the Stockholm Convention, are not confidental;
- Development and implementation of educational and training programmes concerning POPs, such as their health and environmental impacts, alternative to POPs substitute substances, addressed primarily to women, children, people with lowest education level, teachers, scientists as well as technical and managing personnel of enterprises;
- Development and implementation at the national and international level educational and training programmes aimed at rising awareness of the general public on POPs issues, including development and international exchange of educational, training and information materials.

Like in other countries, also in Poland, an important role in developing public participation in the implementation of the provisions of the Stockholm Convention is played by non-governmental organisations (NGOs), in particular undertaking activities connected with environmental protection. The number of such organisations, with various legal status (associations, foundations, movements etc.) and different territorial range (local, national) at present amounts to about 700. It is difficult to give an accurate number because of differences in figures, provided by different sources as well as a great dynamic of changes in this respect (some non-governmental ecological organisations discontinue their activities, change their profile or name and new organisations replace those which disappear). For the majority of these organisations environmental issues are the basic, or even the single objective (for instance, The Nature Conservation League, The Federation of Greens etc.), for others – one of many objectives among which environmental protection is gaining importance (for instance, the Polish Tourist and Sightseeing Association or scout organisations).

It should be noted that apart from all possible differences and changes in the Polish environmental movement, actually all respective organisations are more or less involved in the above mentioned activities, such as education, training, dissemination and exchange of information and ecological lobbing. There is a variety of forms of implementation of these tasks, such as preparation and publishing relevant materials, presenting adequate websites, organising courses, seminars and conferences, competitions and public events, leading public campaigns and protests, establishing contacts and co-operation with public entities and representatives as well as entrepreneurs' organisations, establishing contacts and co-operation with foreign environmental organisations, initiating, supporting and carrying out investigations, studies and experts inquiries etc.

It needs to be stressed that for many years, in spite of emerging difficulties, the environmental movements in Poland have been developing and strengthening. The number of ecological organisations is enormous; they make attempts to reinforce mutual co-operation and co-ordination of activities by concluding adequate agreements and establishing coalitions and networks (such as for instance the Federation of Greens or Polish Green Network). Thanks to the sponsors their financial and technical back-up is extending, the attractiveness and accessibility of their proposals are gaining interest. This is demonstrated by the offer of Internet websites and multimedia publications along with traditional books and brochures, Internet manuals, guidebooks and catalogues along with training and upgrading courses, attempts to work out permanent forms of co-operation with such public institutions as the Ministry of the Environment or the National Fund for Environmental Protection and Water Management, as well as to make contacts and exert the pressure on the Parliamentary Members, business representatives etc. along with protest actions.

Involvement of the Polish NGOs in activities concerning, in particular, human health and environmental protection against POPs is increasing with the growing attention to the newest trends of environmental protection. This is particularly true, when the most contemporary and important environmental problems are identified, together with determination and promotion of solutions to such problems in accordance with the philosophy and principles of sustainable development, with priorities of environmental policy, specifically with its principles of cautiousness, prevention against pollution and hazards to human life and health. For this reason especially stimulated in tackling these issues are, on the one hand, organisations with the widest profile of activities including all aspects of environmental protection and sustainable development, and on the other hand, organisations focussing their attention on human health and environmental protection against the threats constituted by the intensive forms of activity within the contemporary technical civilisation (techniques, technologies and industrial products, chemical methods of agriculture and their side effects in kind of pollution, burdens and waste). Relatively less interest in the POPs issues is demonstrated by organisations specifically involved, for instance, in nature and landscape conservation, conservation and enrichment of biological diversity, protection of cultural treasures and values, etc.

Three non-governmental organisations demonstrate the most intensive activity countrywide:

1. **Polski Klub Ekologiczny (The Polish Ecological Club) – Upper Silesian Branch in Katowice,** among others, dealing with the activities in analytical methodology (HPLC, HRGC, LC, IR, UV) for determination of organic compounds, particularly POPs, transformation of organic substances, particularly carbonic derivatives in different industrial processes (focussed on processes linked to thermal transformation) as well as opportunities to reduce POPs emissions and their impact on environment and human health.
2. **Ogólnopolskie Towarzystwo Zagospodarowania Odpadów „3R”**, seated in Kraków **(National Waste Prevention Association “3R” in Kraków)**, the main animator of a special campaign on elimination of POPs. The main activities concerning POPs performed by that organisation include:
   - Participation in the Steering Committee of the project financed by the Danish Government (within the framework of the DANCEE Fund), implemented by COWI, the Danish consulting company and the Danish Agency of Environmental Protection; aimed at the review of technologies for treatment of hazardous waste containing POPs, which could potentially be the subject of support from Danish Government funds in Central and Eastern Europe, Asia and Africa;
   - Participation in the GEF and Polish Government endorsed GEF/WHO/UNIDO/HCWH Project – „Demonstrating and Promoting Best Practices in Reducing Medical Waste to Avoid Environmental Releases of Dioxins and Mercury from Health Care Practice”, one of the first within the framework of the Stockholm Convention; its implementation shall start after completion of the ongoing preparatory activities, by the end of 2004;
   - Conducting a cycle of training activities for the health service centres on reduction of quantities and toxicity of hospital waste and on replacement of incinerators of such waste by non-emission treatment methods, as well as development of hospital waste management schemes;
   - Maintaining data bases on waste incinerators, including emission data, embracing all countries of the world and accessible for member organisations of the Global Alliance for Incinerator Alternatives (GAIA) network;

- Co-ordination of the information campaign concerning POPs, being prepared by the International POPs Elimination Network Europe in Poland and in some other Central and Eastern European countries;
- Preparation and publication of a synthetic report concerning persistent organic pollutants in Poland and the report summarising the results of research on the presence of POPs in human milk.

3. **Dolnośląska Fundacja Ekorozwoju (The Lowersilesian Foundation of Sustainable Development)** in Wrocław was conducting in 2001 an informative and educational programme under the name "PCB-Stop", aimed at liquidation of equipment and waste containing PCB/PCT. This programme was supported by experts from several research centres (universities, scientific and research institutes) and the interested ministries. Materials concerning this program are found on the websites under: **www.pcb.pl**. The scope of activities was focussed on the following issues:
   - PCB – hazardous waste in environment and in installations;
   - Methods of environmental protection against contamination;
   - Legal aspects of protection and reduction of hazards;
   - Impacts of PCB on human health;
   - Treatment technologies and safe elimination.

12. CONCLUSIONS

The following conclusions can be drawn to summarise the results of the assessment of the Polish situation concerning the 12 substances subject to the Stockholm Convention on persistent organic pollutants, carried out within the Inventory Phase of the GF/POL/01/004 Project:

1. **Legal issues:**
   - The use of pesticides containing substances subject to the Stockholm Convention is legally prohibited in Poland. Also marketing and reuse of PCB is legally banned.
   - The Polish legal system, in general, is compliant with the resolutions of the Stockholm Convention and requires only minor amendments and supplements.
   - Assessment of the efficiency of the existing legal regulations requires some time because of the short period they are in force. The existing authorities and institutions have sufficient competences for the implementation of the Stockholm Convention objectives, though in some instances an extension of the present scope of responsibilities and authorisations will be required.

- Instruments aiming at law enforcement should be introduced, including, for instance, the spectrum of dioxin determination in gases from combustion processes and co-incineration of waste.
- Since 1961 substances covered by the Stockholm Convention have been banned for use in plant protection and the introduction of any new preparations requires approval of the Minister of Agriculture and Rural Development. These permits are periodically updated and published. The Law on the Protection of Cultivated Plants and the Law on Chemical Substances and Preparations regulate the required relevant procedures in this matter.

2. Assessment of past releases:

- In the past (until 1975) the Polish factories of chemical industry applied active substances of DDT, dieldrin and toxaphene for production of pesticides. DDT and toxaphene were produced in Poland while dieldrin and hexachlorobenzene were imported. Among the substances covered by the Stockholm Convention, aldrin, chlordane, endrin, heptachlor and mirex were not used for pesticide production by the Polish chemical industry.
- Chlordane and mirex were not used in Poland as active substances for the production of plant protection chemicals. In general, imported preparations containing active substances such as aldrin, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene and toxaphene were applied.
- During 1949–1971 about 50 000 tonnes of DDT were released into the environment on the Polish territory. The quantity of the remaining POPs released into the Polish environment was many times lower than the above figure. Unfortunately, no information required to define the quantity of all preparations released in the past into the environment in kind of plant protection chemicals containing POPs is available.

3. Inventory of emissions and releases:

- During the recent dozen of years a considerable progress was made in the reconstruction of the chemical industry and reduction or elimination of organic chlorine compounds. At present, no substances covered by the Stockholm Convention are produced in Poland. Measures are taken to eliminate hazards connected to the management of waste and substances found in pesticide landfills.
- The levels of POPs in the Polish aquatic environment remain in most cases below the levels recorded elsewhere in the world.
- In bottom sediments of the Włocławek Reservoir the presence of majority PCB congeners, dioxins and furans, labelled by the WHO as most toxic, including dioxins – 2,3,7,8-TCDD, were detected. The level of toxicity of those sediments, determined by the TEQ value, is higher than at the Oder and Vistula outlet areas.

- From the assessments of PCB, PCDD/PCDF and HCB emissions into the air and releases into the natural ground, water, air, waste/residues and products the following values for the year 2000 were obtained:
  – air emission: PCB – 2320.36 kg, HCB – 8.57 kg, PCDDs/PCDFs – 505.28 g TEQ;
  – release of dioxins and furans into: the soil – 4.96 g TEQ, water – 1.22 g TEQ, waste/residues – 341.3 g TEQ and to products – 10.78 g TEQ.
- Emission of PCBs and HCB to other components of the environment has not been quantified, for adequate factors concerning these types of releases are not available. Development of such factors will be needed for quantitative assessment of POPs releases.
- For the assessment of air emission values, the factors worked out on the basis of the results of Polish research, performed within the GF/POL/01/004 Project, were used with reference to the following sectors: iron ore sintering plants and cement factories (in relation to all pollutants listed above) and in incineration of industrial and hospital waste in modern incineration plants.
- According to the obtained results, the main sources of air pollution emissions are as follows:
  – For PCBs – emission from capacitors and transformers,
  – For HCB – emission from metallurgical industry processes (secondary copper production, sintering plants),
  – For PCDDs/PCDFs – incineration processes in the municipal and household sectors.
- The latest updated information concerning the pesticide landfills is found in the database of the State Geological Institute.

4. **Assessment of effects on human health**
   - Review of available data in terms of estimating exposure to dioxins, PCBs and HCB in Poland and information connected with health risk revealed that data on exposure to dioxins and, to a large extent, to PCBs are insufficient, which reduces the possibilities of health risk assessment.
   - Few details on the content of dioxins and PCB in human milk indicate a high level of exposure of breast fed babies to these chemicals. These data may also be an indication that the human environmental exposure may be subject to justified concern about a potential health hazard.

5. **Monitoring:**
   - There is a need to extend the existing system of the State Environmental Monitoring by adding measurements, control and emission assessment of all POPs covered by the Stockholm Convention, into the air, water and soil by:
     – Monitoring POPs content in industrial and municipal waste landfills,
     – Conducting measurements of dioxin, PCB and HCB emissions at the selected thermal emission sources and paper pulp bleaching processes,

  - Monitoring of the dioxin content in the air in large urban and industrial aglomerations,
  - Monitoring of surface waters and soils regarding POPs content.
- Establishment of a monitoring system on human health hazards caused by dioxins, PCBs and HCB combined with risk assessment of such hazards and evaluation of their changes in time and space.
- It will be necessary to introduce an extended programme of statistical investigations allowing more comprehensive access to economic data related to the scope of the Stockholm Convention influence, in particular data on activities and conditions of waste incineration, particularly hazardous waste, as well as creation of an information system on the content of dioxins, furans, PCBs and HCB in products.

6. Institutional issues:

- The institutional system dealing with POPs is sufficiently developed, it requires however a better co-ordination and consideration of the requirements of the Stockholm Convention in its activities. A higher standard of institutional organisation than the presently existing could solve the problem.
- Implementation of the Convention may suffer a slow down from the following institutional factors:
  - Insufficient staff potential and insufficient qualifications of public administration personnel (particularly at the *poviat* level) responsible for the issue of permits required by the Polish environmental protection regulations.
  - Fast growing scope of responsibilities of environmental protection services at all management levels (including the central level).
- Institutional factors speeding up the implementation of the Convention may be the following:
  - Privatisation process of industry, favourable for the transfer of the best available techniques from highly developed countries to Poland;
  - Market factor, which in result of competition on the European market will favour acceleration of modernisation processes in Polish enterprises.

7. Research and development issues:

- The technical capacity of companies involved in elimination of POPs will be sufficiently developed, according to the National Waste Management Plan.
- There are processing capacities for decontamination of equipment and installations after they are drained of PCBs. However, the issue of meeting the costs connected with such activities, particularly in view of shut down of part of the relevant enterprises where such equipment was in use, is still open.
- Poland has an adequate research capacity allowing conducting the research work on monitoring, control and treatment of POPs as well as assessment of

risk caused by environmental presence of POPs for human health and agricultural production. The fundamental issue, however, is the shortage of funds to support such research projects.

- Poland should be included in the implementation programme on exposure to dioxins and PCBs and on effects of such exposure drafted in the EU strategy for the period of 2001–2010 (Community Strategy for dioxins, furans and polychlorinated biphenyls, COM (2001) 593 final).
- There is a sufficient laboratory capacity to conduct measurements and analyses concerning POPs in Poland, though their activity is limited to selected compounds and does not include the whole set of POPs covered by the Stockholm Convention. The reason for that is lack of necessary funding.
- Completion of the missing standards of dioxin, furan, PCB and HCB content in some food products as well as emission standards from thermal sources is necessary.
- Framework guidelines concerning the rules for proceeding in pesticide landfill clean-up activities need to be developed.
- Because of a very low awareness of the Polish public on harmful influence of dioxins and PCBs and on the related problem of uncontrolled burning of waste at households (in light of the new research results one of the greatest source of emission), an extensive public educational programme on proper waste handling and hazards connected with their burning should be initiated.

ANNEXES

ANNEX 1. ABBREVIATIONS

Abbreviation	Meaning
ADI	Acceptable Daily Intake
ANWIL	Chemical Works former Nitrogen Works WŁOCŁAWEK
BAT	Best Available Techniques
CILP *CIOP*	Central Institute for Labour Protection – National Research Institute *Centralny Instytut Ochrony Pracy – Państwowy Instytut Badawczy*
CIPPSS	Chief Sanitary Inspection (or Chief Sanitary Inspector)
CORINAIR	CORe INventory AIR emission
CORINE	*COoRdination d'INformation Environnementale* An experimental programme for gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the European Community
CSI	Chief Sanitary Inspection (or Chief Sanitary Inspector)
2,4-D	2-methyl-4-chlorophenoxyacetic acid
DDD	1,1-dichloro-2,2-bis(4-chlorophenyl)ethane
DDE	1,1-dichloro-2,2- bis(4-chlorophenyl)ethene
DDT	1,1,1-trichloro-2,2- bis(4-chlorophenyl)ethane
DEP	Department of Ecological Policy, Ministry of the Environment
DEPI	Department of Environmental Protection Instruments, Ministry of the Environment
DIC	Department of International Co-operation, Ministry of the Environment
d.m.	Dry matter
DMDT	1,1,1-trichloro-2,2- bis(metoxyphenyl)ethane
DSB	Permissible concentration in human biological material *Dopuszczalne stężenie w materiale biologicznym u ludzi*
DWR	Department of the Water Resources, Ministry of the Environment
Dz.U.	Official Journal of Laws of the Republic of Poland *Dziennik Ustaw Rzeczypospolitej Polskiej*
EC	European Community
EDI	Estimated Daily Intake
EEA	European Environment Agency
EIONET	European Environment Information and Observation Network
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Abbreviation	Meaning
EPI	Environmental Protection Inspection
EU	European Union
FAO	Food and Agriculture Organization
GAW/WMO	Global Atmosphere Watch/World Metrological Organization
GEF	Global Environment Facility
GIOŚ	Chief Inspectorate (or Chief Inspector) for Environmental Protection *Główny Inspektorat Ochrony Środowiska lub Główny Inspektor Ochrony Środowiska*
GNP	Gross National Product
HCB	Hexachlorobenzene
HCH; γ-HCH	Hexachlorocyclohexan; Lindane
HELCOM	Helsinki Commission – Baltic Marine Environment Protection Commission
HELCOM/EGAP	Helsinki Commission /Group of Experts on Airborne Pollution of the Baltic Sea Area
IARC	International Agency for Research on Cancer
ICRI *IChP*	Industrial Chemistry Research Institute *Instytut Chemii Przemysłowej*
IEIA *IETU*	Institute for Ecology of Industrialized Areas *Instytut Ekologii Terenów Uprzemysłowionych*
IEP *IOŚ*	Institute of Environmental Protection Instytut Ochrony Środowiska
IFM *IMŻ*	Institute of Ferrous Metallurgy *Instytut Metalurgii Żelaza*
IMWM *IMGW*	Institute of Meteorology and Water Management *Instytut Meteorologii i Gospodarki Wodnej*
INFM *IMN*	Institute of Non-Ferrous Metals *Instytut Metali Nieżelaznych*
IOC *IPO*	Institute of Organic Industry *Instytut Przemysłu Organicznego*
IOM *IMP*	Institute of Occupational Medicine *Instytut Medycyny Pracy*
IOMC	Inter-Organization Programme for the Sound Management of Chemicals
IOM&EH *IMPiZŚ*	Institute of Occupational Medicine and Environmental Health *Instytut Medycyny Pracy i Zdrowia Środowiskowego*
IPP *IOR*	Institute of Plant Protection *Instytut Ochrony Roślin*
IUPAC	International Union of Pure and Applied Chemistry
LOAEL	lowest-observed-adverse-effects level (concentration)
LP	State Forests *Lasy Państwowe*
MAR	Maximum Acceptable Residue
MCPA	2-methyl-4-chlorophenoxyacetic acid

Abbreviation	Meaning
MPV	Maximum Permitted Value
NEC	National Emission Centre
NFEP	National Fund of Environmental Protection and Water Management
NGOs	Non-Governmental Organizations
NHSFS *KGPSP*	National Headquarters of the State Fire Service *Komenda Główna Państwowej Straży Pożarnej lub Komendant Główny Państwowej Straży Pożarnej*
NIH *PZH*	National Institute of Hygiene *Państwowy Zakład Higieny*
NLI *PIP*	National Labour Inspection *Państwowa Inspekcja Pracy*
NOAEL	No-observed-adverse-effects level (concentration)
NWMP	National Waste Management Plan
NZPO ROKITA	At present Chemical Works ROKITA
PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzo-p-dioxins
PCDFs	Polychlorinated dibenzofurans
PCTs	Polychlorinated terphenyls
PGR	State Farms *Państwowe Gospodarstwa Rolne*
POPs	Persistent organic pollutants
Preparation	The term „Preparation" means, in case of pesticides, a mixture or solution composed of two or more substances containing one or more active substances, which, in accordance with the Stockholm Convention, may be chemical individual or a mixture of chemical individuals. In respect of such preparations in Poland often the term "ready form" of pesticides (plant protection chemicals) is used. Application of pure active substances as pesticides is not practiced. It is necessary, almost in each case, to match, along with active substances, an adequate composition of supporting substances (solvents, carriers and emulsifiers), to make the safe and comfortable use possible.
PZGS	Powiatowy Związek Gminnych Spółdzielni
RDLP	Regional Directorate of State Forests *Regionalna Dyrekcja Lasów Państwowych*
SEM	State Environmental Monitoring
SGI *PIG*	State Geological Institute *Państwowy Instytut Geologiczny*
SNAP	Selected Nomenclature for Air Pollution
SSI *PIS*	State Sanitary Inspection *Państwowa Inspekcja Sanitarna*
Substances	Substances mean chemical compounds (chemical individuals or mixtures of chemical individuals of similar biological activity) obtained in technical processes. These substances may contain, and contain in most cases indeed, contaminants generated during the production process depending on the selectiveness of that process.

Abbreviation	Meaning
	In relation to pesticides, these contaminants include HCB, PCB, PCDD, PCDF generated in trace quantities during production processes. This is also relevant for the production of polychlorinated biphenyls. In the latter case quite close relations exist between the amount of pollutants (PCDD and PCDF) and the content of chlorine in PCB molecules.
TDI	Tolerable Daily Intake
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNEP Chemicals	UNEP Chemicals' Programme
US EPA	US Environmental Protection Agency
UV-B	Ultraviolet solar radiation having biological effects
WHO	World Health Organization
WIOŚ	Voivodeship Environmental Protection Inspection *Wojewódzki Inspektorat Ochrony Środowiska*
WSSE	Voivodeship Sanitary and Epidemiological Station *Wojewódzka Stacja Sanitarno-Epidemiologiczna*

ANNEX 2. LIST OF PESTICIDE WASTE LANDFILLS ACCORDING TO THE INSTITUTE OF PLANT PROTECTION (A. Siłowiecki)

No.	Voivodeship Place	Waste amount [kg]	Type of landfill				Contamination[1]			Source of information or data	Comments
			Concrete casing	Concrete bunkers and containers	Ditches	Other	Year of test	Underground water	Soil		
1	2	3	4	5	6	7	8	9	10	11	12
	Dolnośląskie										
1	Gościęcice	13 810		●							
2	Grochowice	25 000	●								In operation until 1970
3	Iwiny	45 850		●							Cleaned up during 1975–77
4	Jelenia Góra			●							
5	Kraśnik Górny	2340		●							
6	Lisowice	7000		●							
7	Ludwikowice Kłodzkie	39 220		●			1992		–		LP
8	Ludwikowice Kłodzkie	1500		●							LP
9	Poręba	3100		●							
10	Składowice	5000	●								
11	Spalona	700			●						
	Kujawsko-pomorskie										
12	Białe Błota			●							
13	Bożacin	17 200	●				1987		+	WSSE	In 1987 soil contamination 30 mg/kg, in 1989 not found
14	Dąbrówka	90 000		●			1994	–	+	GIOŚ	1989 no pesticides found
15	Góry Witowskie	10 000		●			1988	–	–	GIOŚ	Inactive since 70s
16	Grębocin	4000	●								1994 GIOŚ

1	2	3	4	5	6	7	8	9	10	11	12
17	Jankowo			●							Pesticides: liquid and powder, class I–IV
18	Kąkol	53 000	●				1994	–	–	GIOŚ	List with the owner
19	Kiełpin	11 810		●			1989	–	+	WSSE	Soil polluted by chlorinated carbohydrates
20	Lisie Kąty	150 000	●		●		1994	–	–	GIOŚ	In operation, destruction of packages – incineration[2]
21	Lubania–Lipiny	23 000		●			1985		+	WIOŚ	In operation, 1985 – DDT 12 mg/kg
22	Małocin	66 500	●				1986		+		In other years no pesticides were found
23	Mąkoszyn	62 000	●								
24	Otłoczyn	10 000	●								
25	Piastowo	12 000	●								
26	Piątkowo	12 000	●								
27	Płocicz	4130		●							
28	Pokrzydowo	350 000		●							
29	Puszcza Rządowa	25 000	●								
30	Rogowo	15 000	●								
31	Sokołowo	7000	●								
32	Stanomin	42 000	●								
33	Stabno	1830			●						
34	Śliwice				●						
Lubelskie											
35	Adamki	8600	●			●					987 kg of pesticides were deposited in the ground in 1969
36	Góry Opolskie	30 000	●								
37	Hrebenne	40 810	●								Also toxic substances landfilled
38	Hruszów	32 500		●			1995	+	+	PIG/IOR	Threat to tap water intake

1	2	3	4	5	6	7	8	9	10	11	12
40	Kaliłow	24 110	●	●							Pesticides+medicines+hazardous chemicals
41	Korolówka	40 000	●	●							New part built in 1984
42	Królewski Dwór	6600	●								
43	Krupe	140 000		●				–	+		Concrete thumbed
44	Łuków	20 000	●								
45	Niedzieliska	40 000	●	●							
46	Parczew	8690	●								
47	Sól										
48	Tomaszów	28 810	●								
	Lubuskie										
49	Gorzów Wielkopolski	5750		●							Landfill of hazardous waste
50	Lipno	1050	●								Chemicals 0.8 m^3, pesticides 125 kg
51	Lutol Suchy	1500	●								Landfill of hazardous waste in operation
52	Staw	14 500	●								
53	Zasieki	2 500		●							
54	Żabice	40 500		●							
55	Bąki	6000	●								
	Łódzkie										
56	Bogumiłów	30 000	●	●							
57	Bujny Szlacheckie	4200			●						
58	Chorzyna	10 000	●	●							
59	Cmentarzyk	700			●		1990	–		GIOŚ	Neighbouring wells tested, result negative
60	Dobków	14 800	●								
61	Jadwinówka	20 000		●			1994	–		GIOŚ	
62	Julków	30 000	●						–		

1	2	3	4	5	6	7	8	9	10	11	12
63	Kazimierzew		●								
64	Księża Wólka	5000	●								LP
65	Kurnos – Borki	8000	●				1994	–		GIOŚ	In 1995 broken by excavator
66	Ładzice				●		1990	–		GIOŚ	Reportedly does not contain pesticides
67	Modlna	21 300	●								
68	Niewiesz	1430	●								
69	Nowy Świat	12 000		●							
70	Ochotnik				●						
71	Pawłówek	150	●								
72	Piotrków Trybunalski	5130		●							
73	Poddębice	760	●								
74	Przerąb				●						
75	Ptaszkowice	7000	●								
76	Radomsko	1000			●						
77	Rochówek				●						
78	Rogów	100				●					
79	Rusiec	8000	●								
80	Sepno–Radonia	20 000		●							
81	Sierzchów	25 000		●							
82	Sulmierzyce	1000			●						
83	Wartkowice	2750	●								
84	Wielgomłyny	1000			●						
85	Zadzim	1500	●								
	Małopolskie										
86	Andrychów	200			●						No accurate location known
87	Baligówka	32 500		●							Toxic substances of class I–V
88	Borzęcin	90			●						
89	Brzesko	800			●						

1	2	3	4	5	6	7	8	9	10	11	12
90	Chełmiec	24 950		●							Closed in the 60s
91	Czchów	270			●						
92	Damienice	5830			●						
93	Dębno	70			●						
94	Gnojnik	280			●						
95	Iwkowa	250									Unknown construction
96	Kalwaria Zebrzydowska	490			●						
97	Kurów	230			●						
98	Libąż	5890	●								LP
99	Lipnica Dolna	30			●						No environmental impact detected
100	Łąkta Górna	530			●						No environmental impact detected
101	Łękawica	1200		●			1994	–	–	GIOŚ	No environmental impact detected
102	Mucharz				●						
103	Pałecznica	20 000	●								
104	Racławice	5000		●							
105	Rzezawa	280			●						
106	Stryszów				●						
107	Szczurowa	120			●						
108	Świebodzin	2000			●						
109	Tuchów	600		●							
110	Wadowice	3160			●						
111	Wojnicz	50			●						
112	Zabawa	320			●						
113	Zakliczyn	40			●						
Mazowieckie											
114	Dobieszyn	15 000	●								

1	2	3	4	5	6	7	8	9	10	11	12
115	Duży Las	46 460	●								LP
116	Grójec	9000	●								
117	Iłża				●						50 kg of pesticides landfilled only once
118	Kamion	30 000		●					–	RDLP	
119	Krzywonoś			●							
120	Opactwo			●							
121	Orońsko	3400		●							
122	Osiny	11 050	●								
123	Podrogów	7700	●								
124	Wielgie	120			●						
125	Zajezierze	50 000		●							
Opolskie											
126	Bogdańczowice	15 300	●				regular	–	–	WIOŚ	Permanent monitoring, no contamination, built in 1976
127	Głuszyna	16 870	●				regular	–	–		No contamination
128	Jędrzychów	35 940	●				regular	–	–		Built in 1974–76, no contamination
129	Krasna Góra	100		●							
130	Wąwelno	19 940	●								
Podkarpackie											
131	Bratkowice	6500	●								LP
132	Brzegi Dolne	2000		●			period	–			
133	Chorówka		●		●						Landfilled before 1965
134	Chyrowa	5000			●						Landfilled before 1965
135	Czermin	50			●						
136	Czudec	50			●						
137	Domaradz				●						Landfilled once before 1965
138	Dukla				●						Landfilled once before 1965
139	Dydynia				●						Landfilled once before 1965

1	2	3	4	5	6	7	8	9	10	11	12
140	Gawłuszowice	60			●						
141	Grabownica Starzeńska				●						Landfilled once before 1965
142	Haczów				●						Landfilled once before 1965
143	Iskrzynia				●						Landfilled once before 1965
144	Jabłonica Ruska	1000			●						
145	Jasienica Rosielna				●						Landfilled once before 1965
146	Kolbuszowa	1000	●			●					
147	Korniaków Prawy				●						
148	Leżachów	2350	●								
149	Łańcut				●						
150	Miejsce Piastowe				●						
151	Niebylec				●						
152	Nozdrzec				●						
153	Ocieka	17 160		●							
154	Olchowice	19 100		●							
155	Ropczyce				●						
156	Smolas	90			●						
157	Szklary	40			●						
158	Wiśniowa				●						
159	Wola Wielka	13 500	●								
160	Zahotyń	310		●							
161	Zarszyn				●						
162	Żołynia				●						
	Podlaskie										
163	Anusin	35 000		●							Protected area of the Bug River valley
164	Baciuty	1000	●								Inventory in 1998 no environ-mental threat
165	Bielany	1000		●							Inventory in 1998; not tested

1	2	3	4	5	6	7	8	9	10	11	12
166	Dębnik	56 000		●							1984 last deposit
167	Folwarki Tylwickie	510	●								In operation
168	Łapy	1270	●								
169	Majdan	300		●							
170	Ryboły	300	●								
171	Słochy (gm Siemiatycze)	4000		●							
172	Wąsosz	90 000		●							
Pomorskie											
173	Bięcino	59 690	●				1994	–	+	GIOŚ	Landfill in operation; hazardous waste, until 1975 – pesticides, later chemicals only
174	Drzewiny	3000	●								
175	Gonty	153 200	●	●			1984	–			1984–86 no soil contamination detected
176	Jęczniki	6000	●	●			periodic	–	–	IOR	Built in 1994–95 for the Plant Protection Institute[3]
177	Skorzewo	42 680		●							
178	Tuchomie	3000	●								
179	Warcz	34 080		●							
Śląskie											
180	Chorzów	180	●								Neutralised in 1976–1982, at present packaging disposal
181	Cieszyn Guldowy	9220	●	●			1978	–		PIS	
182	Czatachowa	8000			●[4]		periodic	–			Test of water from intake 150 m distance
183	Grzybowice										
184	Jaworzno										Organika-Azot[5] Chemical Works own landfill
185	Lipowa	540			●		1983	–	–		Landfilled once in 1960
186	Pilichowice	10 000	●								
187	Pszczyna–Stara Wieś	3 500	●								

1	2	3	4	5	6	7	8	9	10	11	12
188	Radzionków			●							
189	Raszczyce	500	●								
190	Sośnicowice	57 900									Storage of pesticide waste
191	Wojkowice			●							
	Świętokrzyskie										
192	Bałtów	150			●						LP
193	Będziaki	6000	●				1982	–			Former PZGS – rural trade co-operative
194	Biechów	700			●		1982	–			
195	Brzozówka	13 730		●			?	–	–		
196	Budzyń				●						
197	Chłodzawy	15 000	●								
198	Cierno-Żabieniec	25 000	●								Last deposit 1978
199	Ciuślice				●		?	–	–		
200	Czajęcice	4000			●		?	–	–		
201	Drugnia				●						
202	Działoszyce				●		?	–	–		
203	Gnolno	300			●		?	–	–		Landfilled once in 1969
204	Harmoniny				●						
205	Kamienna				●		?	–	–		
206	Kobylniki	900			●		1983	–			Landfilled once in 1969
207	Końskie	4000		●							Former PZGS – rural trade co-operative
208	Kunów	2000			●		?	+[6]			Landfilled once in 1969
209	Miławka	1500			●						
210	Młodzawy Duże	15 000	●								
211	Nieznanowice	10 000	●								
212	Ostrowiec Świetokrzyski	250			●						
213	Ostrowiec Świetokrzyski	10 000			●						
214	Skalbimierz				●						
215	Skrzypiów		●								

1	2	3	4	5	6	7	8	9	10	11	12
216	Szewna	1820			●						
217	Węchadłów				●						
218	Włoszczowice				●						
219	Wojciechówka	47 000	●								
220	Zbrza	50 000	●								
221	Złota				●						
Warmińsko-mazurskie											
222	Brzozówka	22 760	●								
223	Cierpięty	41 000	●								Site cleaned up
224	Czerwonka	7500	●				?		+		Contaminated soil, DDT 500 mg/kg
225	Kamiennik Wielki	65 520		●			periodic	–	–		Until 1982 – 56.8 tonnes of pesticides; last disposal in 1987
226	Kobiela	3300	●								
227	Konopki Wielki	189 500	●	●	●						Storage of packages
228	Kotkowo	9500	●								
229	Lipowa Góra	65 000	●								
230	Matyski k Brzozówki	5000	●								
231	Nowe Guty	84 000	●								
232	Różyna	6000	●								
233	Rywociny	160 000	●								
234	Siniec	14 000	●								
235	Warlity Wielkie	3500	●								
236	Węgajty	30 000	●								
237	Wozławki	9000	●								
Wielkopolskie											
238	Czempiń	15 800		●							
239	Franciszkowo	16 480	●								After 1979 packaging landfill only

1	2	3	4	5	6	7	8	9	10	11	12
240	Głażewo	14 400	●		●						Ashes from burned packaging dumped in pitches
241	Gniezno	8000		●							Hazardous waste landfill in operation
242	Górnica	22 960	●	●			periodic	–	–		After 1979 packaging landfill only
243	Grabówka				●						
244	Grabów-Wójtostwo	10 510	●	●							Located near water reservoir[7]
245	Hiszpania	77 790	●								Located near water reservoir, used until 1977[7]
246	Klotyldzin	25 000	●		●						
247	Kopanki	6600	●				periodic	–	–	PIS	Located near water reservoir[7]
248	Lasocice	1030	●				1987	–			
249	Matuszewo	100 000		●							
250	Młynów	30 000	●								
251	Nadziejewo	12 600		●							
252	Niedźwiady	65 800									Pesticide waste storage
253	Nowa Obra				●						
254	Ostrolesie	3100	●								
255	Piotrkówko	6500		●							
256	Poznań	1000	●								
257	Poznań	10 000		●							
258	Prochy	14 000			●[8]						
259	Przybyszów	122 000	●								
260	Skubarczewo	26 000	●								
261	Studzieniec	10 000	●								
262	Tworzymirki–Gaj	8500	●								
263	Wagowo	61 4300	●	●							
264	Zwola	6 200		●							

1	2	3	4	5	6	7	8	9	10	11	12
Zachodniopomorskie											
265	Banie	38 400	●				1889	–			Pesticides class I–V and chemicals
266	Bądkowo	26 000	●				?	–			
267	Brojce	7200	●								
268	Brzeźniak	134 400		●							
269	Chojna	28 800	●								
270	Chrząstowo	114 000	●								
271	Dalewo	6000	●				?	–			
272	Dobra	11 300					?	–			
273	Dolice	9600	●				?	–			
274	Drzonowo Białogradzkie	5200	●								LP
275	Gołańcz Pomorska	21 600	●				?	–			
276	Karnice	2400	●				1981	+[9]			
277	Kołomąć	12 800	●				?	–			
278	Kurzycko	20 000	●				?	–			
279	Kwieciszewo		●								
280	Linie		●								
281	Marszewo	36 000	●								
282	Modrzewo		●								
283	Niemierzyno	10 000	●	●							
284	Osiek Drawski	20 000	●								
285	Osina	8000	●								
286	Ostrowiec	166 000	●								
287	Piaski	8000	●								
288	Pomień	15 000	●								
289	Rów	24 500	●								
290	Rymań		●								
291	Rymań	630	●								
292	Sianów	32 950	●								
293	Skrzydłowo	20 630		●							

1	2	3	4	5	6	7	8	9	10	11	12
293	Skrzydłowo	20 630		●							
294	Smolnica	2000	●								
295	Stara Dąbrowa	12 000	●								
296	Stara Dobrzyca	115 000		●							
297	Wąwelnica		●								
298	Wierzbnica		●								
299	Wierzbnicz		●								
300	Wiewiecko	86 400	●								
301	Więcław	122 200	●								
302	Wisławie		●								
303	Wołczyn	12 000	●								

● Type of landfill
[1] Contamination of water or soil by plant protection chemicals: + found; – not found.
[2] In the years 1985–1992, 500–1500 kg of packages left after the use of pesticides, were burnt out.
[3] It was built for the Institute of Plant Protection, Field Station in Człuchów.
[4] Placed with concrete, covered by a concrete slab.
[5] Separately described as industrial waste landfill.
[6] Trace quantities in water.
[7] The main reservoir of drinking water.
[8] Insulated pit, no information on insulation method.
[9] DDT (not found in other years).

Notice:
For all abbreviations (LP, WSSE, GIOŚ, WIOŚ, PIG, IOR, RDLP, PIS) see Annex 1.

ANNEX 3. RESULTS OF THE SURVEY OF LABORATORIES CONCERNING THEIR CAPACITY TO DETERMINE THE CONTENT OF POPs COVERED BY THE STOCKHOLM CONVENTION

No. of question-naire	Laboratory	PCBs	HCB	PCDDs/ /PCDFs	Eight remaining POPs
1	2	3	4	5	6
1	WIOŚ Wrocław	all media	all media	–	all
2	WIOŚ Bydgoszcz	surface water, (solid waste) (bottom sediments)	surface water, (solid waste) (bottom sediments)	–	all, except toxaphene
3	WIOŚ Lublin	all media	all media		all
4	WIOŚ Kraków	–	surface water		all
5	WIOŚ Rzeszów	surface water, (solid waste) (bottom sediments)	surface water, (solid waste) (bottom sediments)	all media	aldrin, dieldrin, heptachlor, DDT
6	WIOŚ Białystok	water	–	–	
7	WIOŚ Katowice (Bielsko Biała)	water	–	–	
8	WIOŚ Katowice (Częstochowa)	(surface water)	–	–	
9	WIOŚ Kielce	water	–	–	
10	WIOŚ Olsztyn	water	water	water	
11	WIOŚ Olsztyn (Elbląg)	water	water	–	all
12	WIOŚ Poznań	water	water	–	all, except toxaphene
13	WIOŚ Poznań (Kalisz)	water	–	–	DDT
14	WIOŚ Poznań (Leszno)	(water)	–	–	DDT
15	WIOŚ Poznań (Konin)	woda	–	–	–
16	WIOŚ Poznań (Piła)	–	–	–	DDT

1	2	3	4	5	6
17	WIOŚ Szczecin	water	(water)	–	all
18	WSSE Gorzów	–	(potable water)	–	aldrin, heptachlor, DDT
19	WSSE Kraków	–	food	–	aldrin, dieldrin, heptachlor, DDT
20	WSSE Warszawa	water, foods	water, foods	–	aldrin, dieldrin, heptachlor, DDT
21	WSSE Białystok	–	(potable water)	–	DDT
22	WSSE Kielce	–	food	–	aldrin, dieldrin, endrin, heptachlor, DDT
23	WSSE Olsztyn	–	–	–	aldrin, dieldrin, heptachlor, DDT
24	WSSE Poznań	–	(potable water)	–	aldrin, dieldrin, endrin, heptachlor, DDT
25	Kraków University of Technology	all media	all media	all media	DDT
26	IETU Katowice	water	water	–	all except for dioxins and furans
27	IMGW Wrocław	(all media)	–	–	DDT
28	IMGW Gdańsk	all media	all media	all media	all
29	IMGW Warszawa	(all media)	–	–	DDT
30	State Geological Institute	water, precipitation, bottom sediments	water, precipitation, bottom sediments	–	all, except for mirex and toxaphene
31	National Institute of Hygiene Warsaw	(plants) (foods)	(plants) (food)	–	all, except for mirex and toxaphene
32	Institute of Plant Protection, Poznań	–	water, food	–	aldrin, dieldrin, endrin, heptachlor, DDT
33	Institute of Chemical Carbon Processing	–	all media	–	–

1	2	3	4	5	6
34	Institute of Environmental Protection	water, solid waste, bottom sediments	–	–	–
35	Wrocław University of Technology	(water), (solid waste) (bottom sediments)	(water)	–	aldrin, dieldrin, heptachlor, DDT
36	Gdańsk University of Technology	(air), water, (solid waste), bottom sediments, plants	(air), water, (solid waste), bottom sediments, plants	–	all – without DDT except toxaphene & DDT
37	Poznań Medical University	(solid waste), bottom sediments, (plants), foods	–	–	–
38	Institute of Marine Fisheries, Gdynia	foods	food	–	heptachlor, DDT
39	Military Institute of Chemistry and Radiometry	all media	(water) (solid waste) (sediments) (food)	all media	endrin, dieldrin, heptachlor, DDT
40	National Foundation of Environmental Protection	all media	all media	all media	all, except mirex
41	Institute of Meat and Fat Industry	(water)	(water)	(water)	all

Text in brackets ( ) means the lack of preparedness of a laboratory to be subjected to inter-laboratory tests in this respect. In columns for PCB, HCB and for dioxins and furans, the media, in which the determinations are performed, have been indicated. In column 6: „Eight remaining POPs" information is given for what contaminants the measurements are performed. The contamination may be determined in the media different than those for PCB and HCB.

ANNEX 4. LABORATORIES WITH THE GREATEST POTENTIAL IN RELATION TO DETERMINING PERSISTENT ORGANIC POLLUTANTS

Name of laboratory	National Foundation of Environmental Protection (NFEP), Environmental Chemistry Department in Warsaw	Institute of Meteorology and Water Management (IMWM), Division of Coastal Drainage Water Protection in Gdańsk
1	2	3
General description of research	• Determination of organic compounds in the environment, including POPs, since 20 years. • Development of several methods to determine the content of chloroorganic compounds in air, water and wastewater.	
Ongoing and completed activities	Several dozens of completed undertakings on organic compounds and POPs.	Ongoing activities: • analysis of trends and course of quantitative and qualitative processes going on in rivers, lakes and water reservoirs; • evaluation of changes in meteorological, hydrological and chemical processes taking places in marine environment of Southern Baltic Sea and on coastal areas; • implementation of modern methods for acquisition and presentation of current information on the state of marine environment; • methods to determine general toxicity and the content of halogen-organic compounds in the assessment of domestic surface waters and bottom sediments; • International Oder Project; • creation of the Pomeranian Hazardous Substances Laboratory within the structure of IMWM, Division of Coastal Drainage Water Protection in Gdańsk; • MANTRA East – 5th Framework Programme. Discharge of pollutants into the Vistula Bay.

1	2	3
Publications	Selected, generally accessible publications: • J. Bartulewicz, J. Gawłowski, E. Bartulewicz, Application of gas and liquid chromatography for determination of environmental pollutants. *Biblioteka Monitoringu Środowiska*, Warsaw 1997. • J. Bartulewicz, J. Gawłowski, E. Bartulewicz. Sampling and processing of samples for determination of organic compounds by chromatographic methods. Part I – Water, Part II – Air. *Biblioteka Monitoringu Środowiska*, Warsaw 1997. • J. Bartulewicz, E. Bartulewicz, J. Gawłowski, J. Niedzielski, Simple and rapid method for the determination of methyl chloride, ethylene dichloride, trichloroethylene and tetrachloroethylene in atmospheric air. *Chemia Analityczna* 43, 887 (1998). • *(Polish Standard)*-PN-Z-04237:1994 Air protection – Determination of dichloromethane, 1,2-dichloroethane, trichloroethylene and tetrachloroethylene in atmospheric air (imission) gas chromatography method. • Method recommended by the Chief Inspectorate of Environmental Protection. Determination of 1,1-dichloroethylene, trichloroethylene, tetrachloroethylene and tetrachloromethane in water and wastewater by the gas chromatography method (several dozen of items in total).	Publications in the period 2001–2002 • Niemirycz, A. Kaczmarczyk, 2002, International research programs as a base for information on persistent organic compounds in the natural environment. *Mat. Komitetu Gosp. Wodnej PAN*, Jachranka 2002 (in print). • J. Dojlido, E. Niemirycz, 2002, Monograph By-products of water disinfection. *Wodociągi i Kanalizacja*, No. 9, Warsaw, 179–184. • Heybowicz, T. Bogacka, R. Taylor, E. Niemirycz, 2001, Methods to determine the origin of nitrogen and phosphorus discharged by rivers into the Baltic Sea. *Wiadomości IMGW*, XXIV (XLV), issue 1, Warsaw, 11–21. • M. Sosnowska, A. Kaczmarczyk, E. Niemirycz, J. Szafranek, 2001, Chemometrics as a method to gain information in environmental research., *Mat. Komitetu Gosp. Wodnej PAN*, Czorsztyn 11–13.10.2000, IMGW, Warsaw, 77–91. • A. Kaczmarczyk, M. Sosnowska, E. Niemirycz, 2001, Transport of pollution loads by rivers. Toxic organic substances in the Oder River in relation to EU Directives. (in: *Warunki środowiskowe polskiej strefy południowego Bałtyku w 1999 r., Materiały Oddziału Morskiego, IMGW*, Gdynia, 260–265. • E. Niemirycz, E. Heybowicz, Z. Makowski, M. Sosnowska, 2001, Transport of pollution loads by rivers. Discharge of contaminating substances into the Baltic Sea (in: *Warunki środowiskowe polskiej strefy południowego Bałtyku w 1999 r. Materiały Komitetu Gosp. Wodnej PAN*, Czorsztyn 11–13.10. 2000, IMGW, Warsaw, 77–91.

1	2	3
		• E. Niemirycz, M. Sosnowska, A. Kaczmarczyk, 2001, PAHs in river bottom sediments (in: Editor J. Siepak). *Problemy analityczne badań osadów dennych, Sympozjum naukowe Komitetu Chemii Analitycznej PAN*, Komisja Analizy Wody, Radom-Jedlnia, Poznań.
Measurement methods applied	Standards of ISO, CEN and own analytical procedures are applied. All measurement methods applied by the National Foundation (including own standards and methods) are validated on the basis of the tests on samples marked by internal patterns or, when such opportunity exists, based on reference materials. With reference to POPs, among others, the following ISO standards were implemented: • EN ISO 10301 Water quality – Determination of highly volatile halogen hydrocarbons – Gas chromatographic method. • ISO 6468.2 Water quality – Determination of certain chloroorganic insecticides, polychlorinated biphenyls and chlorobenzenes – gas chromatographic method after liquid-liquid extraction. • EN12673 Water quality – Gas chromatographic determination of some selected chlorophenols in water. • EN1948 – Stationary source emissions – Determination of the mass concentration of PCDDs/PCDFs. Part 1, 2 i 3.	• gas and liquid chromatography; • mass spectrometry; • visible and ultraviolet area (absorption and emission) and infrared spectrophotometry; • coulometery; • biological tests of general toxicity (Microtox system).
Measuring equipment used	• Capillary gas chromatographs with FID, ECD detectors – Hewlett-Packard, Shimadzu. • GC-MS QP-5000 system – Shimadzu, Wiley and NIST mass spectrum libraries.	• HP gas chromatograph with MSD – mass detector. • HP and Fisons gas chromatograph with ECD – electrons catching detector. • HP gas chromatograph with FID – fire ionisation detector.

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	• HPLC system, with fluorometric detectors and diode, high pressure gradient – Shimadzu. • Systems for SPME Supelco. • Various sets for extraction by solvents liquid-solid, liquid-liquid, SPE, "purge and trap". • Sets for cleaning by classic methods of liquid chromatography on adsorption, separation and excluding beds • EMIO dust meter. • GA60 analyser. • Equipment (electronic measuring devices) for setting parameters of gas flows, temperature, pressure (dynamic and static), humidity, etc. • Laboratory equipment of general application.	• multi N/C apparatus for measurement of the OWO/RWO parameter; • micro X apparatus for measurement of the AOX/EOX parameter; • microbics M 500 Analyser for measurement of general toxicity in the Microtox system.
Accreditations	PCA not in hand.	Accreditation of the Polish Ship Register (International Recognition Certificate No. TM/687/71 0001/99) for determination in waters and wastewaters from ships: contents of oil derivative substances, chemical and biochemical oxygen demand, suspension, free chlorine and sulphides as well as coli titre (valid until 2004).
Inter-laboratory tests	• Participation in five comparisons organized by the Institute of Occupational Medicine in Łódź (1996–1998) concerning determination of benzene in air at the level ppm-ppb (all tests completed positively). • Participation in the test on determination of BTEX in water at the ppb level, organized by the State Geological Institute (2001), with a positive result, and the deviation from the reference value did not exceed few percent.	• Certificate of participation in an international EQUATE (Equal quality of water – related analyses throughout Europe) during 1995–1998, financed by the European Union – CIPA-CT94-0173. • Comparison of determination of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment samples, carried out at the laboratory 20 WP of NILU in Norway and the laboratory of NILU – 2002. • Performance of countrywide comparative tests of WIOS laboratories commissioned by the environmental sector.

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Personnel training and professional experience	Experts with high qualifications and many years of experience in analytics on environmental pollution. Two staff members are the members of the Problem Sub-Committees of the Polish Standardization Committee, and also delegates of Poland to the International Standard Organization's technical bodies. The teams' achievement is the development of 18 Polish Standards, teens of analytical methods used by the State Environmental Protection Inspectorate, tens of scientific publications concerning the analyses of organic environmental pollution. The NFEP Environmental Chemistry Section was during 1989–2000 among the organizers of the scientific symposium "Organic compounds in the environment and methods of their determination". Within the framework of these meetings, as well as many others, the team members presented teens of papers and communications concerning determination of organic compounds in the environment and on methods of assessment of errors as well as establishment of uncertainty in analytical methods.	• Training in methods of testing organic compounds by the "non-target screening" method at the University of Hamburg (Prof. Witko Franke), July 2000. • Training in dioxins, furans and coplanar PCBs determination at the Norwegian Institute of Public Health w Oslo (Prof. Georg Becher), February 2002. • Training in determination of AOX and EOX at the Analitik Jena IDC in Jena, January 2002. • Training course "Biologic indication – biological methods in testing environmental toxicity", at the Environmental Research Division of the Medical University Warsaw, May 2002.
Name of laboratory	**Trace Analyses Laboratory, Institute C-1 of the Kraków University of Technology**	**Environmental Protection Laboratory at the Institute for Pulp and Paper in Łódź**
General description of research	Determination of POPs, with particular consideration of polychlorinated dibenzodioxins, dibenzofurans and biphenyls in samples from environment, industrial products, foodstuffs and combustion gases. Experience in determination of polychlorinated dibenzodioxins and dibenzofurans since 1989.	Own projects: Dioxin environmental pollution by cellulose and paper industry with particular consideration of the technology for bleached sulphate pulp production and the impact of tecthnologies applied in the pulp and paper industry on generation and emission of toxic compounds.

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Ongoing and completed activities		Participation in research projects of the Łódź University of Technology: • 7/T09B 044 20: Choice of active and persistent catalysers to eliminate dioxins emission in the process of neutralisation of selected organic chloride compounds; • PB 0963/T09/01/020/22: Application of catalysers in thermal processes of neutralisation of organic compounds of sulphur and nitrogen found in wastes. Preparation for measurement of pollution from a waste incineration plant, including emission of dioxins and furans, in accordance with the standard PN EN-1948. Analysis of samples of dust of condensate and adsorbent XAD-2 for the content of dioxins and furans, according to the above-mentioned standard. During 2001 and 2002, eight series of measurements in Polish hospital waste incineration plants were performed.
Publications	• Grochowalski A., Wybraniec S. "Levels of polychlorinated dibenzo-p-dioxins and dibenzofurans in flue gas and fly ash from coal combustion in a power plant". *Chemia Analityczna* (Warsaw) 41, 27–34, 1996. • Grochowalski A., Chrząszcz R., Pielichowski J. "PCDD/F mass concentration in residues from incineration of medical wastes in Poland". Organohalogen Compounds, 27, 42–46, 1996. • Grochowalski A., Chrząszcz R. "PCDDs/Fs in suspended particulate matter in ambient air from Krakow City, Poland". Organohalogen Compounds 32, 76–80, 1997.	• B. Pszonka, M. Michniewicz, J. Stufka-Olczyk: Dioxins hazard to the environment. *Zagrożenie środowiska dioksynami. Ochrona Powietrza i Problemy Odpadów* 1996 R.5 p. 160. • M. Michniewicz, J. Stufka-Olczyk: Analytical method for determination of TCDD and TCDF in pulp and paper mills effluents. Acta Chromatographica 1996 R.6 p. 116. • J. Stufka-Olczyk, M. Michniewicz, A. Milczarek: Determination of phenols and chlorophenols in pulp and paper wastewater. *Oznaczanie fenoli i chlorofenoli w ściekach celulozowo-papierniczych. Materiały z XXII Sympozjum Naukowego nt.: Chromatograficzne metody badania związków organicznych*, Katowice-Szczyrk, June 1998 p. 150.

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	• Grochowalski A., Wiater I. 1998. Carbon Column as a Clean-up Method for Oily Samples Purification for the Determination of Polychlorinated Dibenzo-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs). *Chemia Analityczna* (Warsaw) 43: 399–408. • Grochowalski A. 1998. PCDDs and PCDFs Concentration in Combustion Gases and Bottom Ash from Incineration of Hospital Wastes in Poland Chemosphere 37 (9–12): 2279–2291. • Grochowalski A. Report on the state of the environment of Kraków in. 1994–1998. *Raport o stanie środowiska naturalnego miasta Krakowa w latach 1994–1998 r., Biblioteka Monitoringu Środowiska*: 155–162. • Grochowalski A., Piekło R., Gasińska A., Chrząszcz R., Gregoraszczuk E.L. 2000. Accumulation of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in porcine preovulatory follicles after *in vitro* exposure to TCDD: effects on steroid secretion and cell proliferation. Cytobios, 102: 21–31. • Grochowalski A., Chrząszcz R. 2000. The Result of the Large Scale Determination of PCDDs, PCDFs and Coplanar PCBs in Polish Food Product Samples using GC-MS/MS Technique. Organohalogen Compounds 47: 306–310. • Gregoraszczuk E.L., Piekło R., Grochowalski A. 2000. 2,3,7,8-tetrachlorodibenzo-p-dioxin Action on Metabolism of Cholesterol and Testosterone by Folicular Cells in Culture. Organohalogen Compounds 49: 330–335.	• J. Stufka-Olczyk, M. Michniewicz, A. Milczarek: Gas chromatography – mass spectrometry in determination of organic and organic chloride compounds toxic to eco-systems. *Chromatografia gazowa – spektrometria masowa w oznaczaniu toksycznych dla ekosystemów związków organicznych i chloroorganicznych. Materiały III Konferencji Bory Tucholskie-Ochrona Biosfery, Uniwersytet Łódzki, Katedra Biofizyki Ogólnej*, 1998 p. 145. • G. Nałęcz-Jawecki, J. Sawicki, M. Michniewicz, J. Stufka-Olczyk: Toxicity of chlorinated phenolic compounds occurring in pulp mill effluents. Proceedings of the conference: „Organochlorine Pollution in Central and Eastern Europe – Hazard and Risk for Humans and the Environment, September, Balatonföldvar, Hungary, 1999. • M. Michniewicz, J. Stufka-Olczyk: Determination of toxic compounds generated in kraft pulp production processes. *Materiały III Międzynarodowej Konferencji n.t.* „Chemical Industry and Environment", Zabrze 1999, p. 595. • M. Michniewicz, G. Nałęcz-Jawecki, J. Stufka-Olczyk, J. Sawicki: Comparison of chemical composition and toxicity of waste waters from pulp industry „New Microbiotests for Routine Toxicity Screening and Biomonitoring", Kliwer Academic/Plenum Publ. London 2000 p. 401. • J. Stufka-Olczyk, M. Michniewicz: Coulometric determination of organically bounded halogenes and sulphur. *Kulometryczne oznaczanie organicznie związanych halogenów i siarki. Materiały konferencyjne n.t. „Analiza śladowa związków organicznych".* Jachranka May 2000, p. 156.

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	• Grochowalski A., Chrząszcz R., Piekło R., Gregoraszczuk E.L. Estrogenic and antiestrogenic effect of in vitro treatment of follicular cells with 2,3,7,8-tetrachlorodibenzo-p-dioxin. Chemosphere 2000, vol. 43/4–7, p. 823–827. • Grochowalski A., Milewicz T., Krzywda A., Krzysiek J., Gregoraszczuk E.L. Polychlorinated biphenyls in placental tissue from normal versus abnormal pregnancy outcomes: preliminary results. Polish Journal of Gynaecological Investigations 2000, 3 (2), 71–74. • Grochowalski A. Research on determination of polychlorinated dibenzodioxins, dibenzofurans and biphenyls. *Badania nad oznaczaniem polichlorowanych dibenzodioksyn, dibenzofuranów i polichlorowanych bifenyli. Monografia nr 272, Zeszyty Naukowe Politechniki Krakowskiej,* Kraków 2000. ISSN 0860-097X. • Grochowalski A. Pro and Contra using EN-1948 for dioxin measuring in stack gases from co-incineration of hazardous wastes in cement kilns and power plants in Poland. VDI-Berichte: Measuring Dioxin Emission, Düsseldorf 2001, 1585, 61-68. ISBN 3--18-091585-4.	• G. Nałęcz-Jawecki, J. Sawicki, M. Michniewicz, J. Stufka-Olczyk: Toxicity of major pollutants occurring in the pulp and paper mill effluentp. Acta Poloniae Toxicologica, 2000, 812, p. 263. • J. Stufka-Olczyk, M. Michniewicz: Coulometry – quick method for determination of organically bounded halogenes and sulphur. *Kulometria – szybka metoda oznaczania organicznie związanych halogenów i siarki.* LAB 2000. • Z. Gorzka, M. Kaźmierczak, A. Żarczyński, M. Michniewicz, Tadeusz Paryjczak: Effect of temperature on composition of combustion gases and efficiency of thermocatalytic oxidation of 1,2-dichloropropane, Materials of 14th International Congress of Chemical and Process Engineering CHISA 2000, 27–31 August, Prague, Czech Republic. • J. Stufka-Olczyk, M. Michniewicz: Dioxin synthesis in bleached pulp mass production processes. *Tworzenie się dioksyn w procesach produkcji bielonych mas celulozowych Materiały Międzynarodowej Konferencji „Dioksyny w przemyśle i środowisku”,* Kraków, June 2001, p. 106. • Z. Gorzka, A. Żarczyński, T. Paryjczak, M. Michniewicz, M. Kaźmierczak: Opportunities for elimination of dioxins in processes of neutralisation of liquid industrial wastes. *Możliwości eliminacji dioksyn w procesach unieszkodliwiania ciekłych odpadów przemysłowych Materiały Międzynarodowej Konferencji „Dioksyny w przemyśle i środowisku”*, Kraków, June 2001 p. 96.

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		• J. Stufka-Olczyk, M. Michniewicz, A. Milczarek: Determination of butylocine compounds in papers by the GC/MS method. *Oznaczanie związków butylocyny w papierach metodą GC/MS. Materiały z XXV Sympozjum Naukowe nt.: Chromatograficzne metody badania związków organicznych, Uniwersytet Śląski, Instytut Chemii*, 2001 p. 96. • Żarczyński, Z. Gorzka, T. Paryjczak, M. Kaźmierczak, M. Michniewicz, J. Stufka-Olczyk: Oxidation of 1,2-bichloropropane in the presence of the copper-zinc catalyst. *Utlenianie 1,2-di-chloropropanu w obecności katalizatora miedziowo-cyn-kowego TMC 3/1. V Ogólnopolska Konferencja Naukowa „Kompleksowe i Szczegółowe Problemy Inżynierii Środowiska,* Ustronie Morskie, 24–27 May 2001. • M. Kaźmierczak, T. Paryjczak, J. Stufka-Olczyk, M. Misiak, A. Żarczyński: Inflence of sulphur compounds on emission of dioxins from the catalytic process of 1,2- bichloropropane oxidation. *Wpływ związków siarki na emisję dioksyn z procesu katalitycznego utleniania 1,2-dichloropropanu. Materiały VI Konferencji Naukowej „Dioksyny w Przemyśle i Środowisku",* Kraków, September 2002, p. 47. • Żarczyński, Z. Gorzka, M. Kaźmierczak, M. Michniewicz: Emission of dioxins in the process of tetrachloroethylene oxidation in the presence of platinum catalyser. *Emisja dioksyn w procesie utleniania tetrachloroetylenu w obecności katalizatora platynowego. Materiały VI Konferencji Naukowej „Dioksyny w Przemyśle i Środowisku",* Kraków, September 2002, p. 55.

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		• M. Michniewicz, A. Borowski, J. Stufka-Olczyk: Emission of pollution from the hospital waste incineration process – experience of domestic incineration facilities. *Emisja zanieczyszczeń z procesu spalania odpadów medycznych – doświadczenia krajowych spalarni – referat na VI Ogólnopolską Konferencję Naukową pt.: Kompleksowe i szczegółowe problemy inżynierii środowiska,* Koszalin – Ustronie Morskie 29.05–1.06. 2003.
Measurement methods applied	EPA 1613 Determination of polychlorinated dibenzo-dioxins and dibenzofurans using HRGC-HRMS and isotope dilution method. EN1948 - Stationary sources emission - Determination of the mass concentration of PCDDs/PCDFs. Part 1, 2 & 3. Own developed procedures for determination of poly-chlorinated dibenzodioxins, dibenzofurans and biphe-nyls in various kinds of matrixes based on membrane methods SPM as well as gas chromatography tech-niques and mass spectrometry with multigrade fragmentation of molecule – GC-MS/MS.	• Preparation of samples for chromatographic analysis: solvent extraction (liquid-liquid, solid-liquid), extraction to solid body (spe), column and gel chromatography, concentration to very small volumes. • Chromatographic analysis: gas chromatography with FID, ECD detection and MSD.
Measurement equipment used	Chromatographic system GC-MS/MS Thermoquest Finnigan GCQ plus MS/MS – two apparatus and systems for samples preparation based on extraction ASE, SPM, freeze-drying and the HPLC Gynkotek with the detector gradient system.	• Gas chromatograph coupled with mass selectivity detector (GC/MS) made by Hewlett-Packard, model 5890, series II / 5972, programme and spectra upgraded in 2001. • Gas chromatograph with FID and ECD detectors made by Varian, model 3400.
Accreditations	PCA not in hand.	Laboratory application for PCA accreditation submitted, application No. W-020/2001. Accreditation audit planned for December 2003.

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Inter-laboratory tests	Since 1996, participation in annual international inter-laboratory comparisons concerning determination of polychlorinated dibenzodioxins, dibenzofurans and biphenyls organised by the University of Umea and Orebro in Sweden, Ontarion Ministry of State in Canada and the University of Venice. In 10 international comparisons all results achieved were positive and are accessible on websites. In 2001 and 2002 our laboratory had the code number 58. The report about international comparison of dioxin determination is accessible on websites: http://www.chem.umu.se/dep/envichem/intercalib/ kod nr 58 Username: admgri Password: wfqowplh.	Inter-laboratory comparative tests on PCDDs, PCDFs and HCB determination, November 2002.
Personnel training and professional experience	Professional experience: Two research workers – one with the grade of Doctor Habil. Eng., two engineers, technicians with 10 years of experience in determining polychlorinated dibenzodioxins, dibenzofurans and biphenyls. Laboratory, as the only one in Poland, was performing during 1999–2000 determination of dioxins in samples of food stuffs and industrial products on the order of the Ministry of Agriculture and Rural Development during the "Belgian Broiler Affair" in 1999. The manager of the laboratory Dr. Hab. Eng. Adam Grochowalski is member of the European Standardisation Commission CEN 264 WG01 involved in standards of dioxin determination in stack gases and atmospheric air. Organiser of 6 international scientific conferences on "Dioxins in industry and environment" starting from 1996, devoted mainly to issues of dioxins analyses.	Professional experience: 2 staff members with technical university education (Łódź University of Technology, Faculty of Chemistry) and Ph.D. degrees, one of them with 25 year of experience in gas chromatography techniques; 1 staff member with technical university education, M.Sc., Eng. in chemistry, 1 staff member with higher technical education, technician in chemistry, 20 years laboratory experience, 2 staff members with completed post-graduate studies on trace analysis and home country and foreign training in operation of gas chromatography equipment. Members of the laboratory staff are often participating in seminars and workshops organised by producers and suppliers of modern equipment and installations of instrumental analysis, particularly gas chromatography. They also take part in Chromatography Conferences, as being invited annually by the Silesian University and Branches of the Polish Academy of Sciences in Katowice and Zabrze.

ANNEX 5. LIST OF SOURCE DOCUMENTS

A. LIST OF DETAILED REPORTS[1] DEVELOPED WITHIN PROJECT ACTIVITIES

List of technical reports prepared by experts during the Inventory Phase

GF-POL-INV-R1
Adam Grochowalski. *Report on the performed measurements and concentration tests of PCDDs/PCDFs, HCB and PCBs.* University of Technology in Krakow, Department of Chemical Engineering and Technology, Institute of Inorganic Chemistry and Technology, Laboratory of the Trace Analyses Team, 2002.

GF-POL-INV-R2
Krzysztof Olendrzyński, Iwona Kargulewicz, Wiesław Kołsut, Jacek Skośkiewicz, Bogusław Dębski, Adam Grochowalski. *Countrywide inventory of POPs air emissions and analyses of releases into the remaining environmental media*, 2002.

GF-POL-INV-R3
Elżbieta Niemirycz (head), Anna Kaczmarczyk, Mirosława Rodziewicz, Grażyna Sapota, Mariusz Sapota, Elżbieta Heybowicz, Teresa Bogacka, Regina Taylor. *Water quality assessment of the Vistula and Oder Rivers' mouth sections in respect of persistent organic pollutants, covered by the Stockholm Convention 2001.* Institute of Meteorology and Water Management, Maritime Branch, Division of Coastal Drainage Water Protection, 2002.

GF-POL-INV-R4
Elżbieta Niemirycz, Anna Kaczmarczyk, Mirosława Rodziewicz. *Pollution of the aquatic environment in Poland by persistent organic pollutants.* Institute of Meteorology and Water Management, Maritime Branch, Division of Coastal Drainage Water Protection, 2002.

GF-POL-INV-R5
Wanda Kacprzyk. *Assessment of the research and development capacity and the laboratory testing capability in respect of the persistent organic pollutants.* Institute of Environmental Protection, 2002.

GF-POL-INV-R6
Wanda Kacprzyk. *Assessment of the institutional infrastructure, monitoring system and public statistics capacity concerning wastewater management and water protection against POPs.* Institute of Environmental Protection, 2002.

GF-POL-INV-R7
Krzysztof Czarnomski. *Condition of POPs waste management in Poland,* 2002.

[1] Documents available only in Polish language on the Project websites http://ks.ios.edu.pl

GF-POL-INV-R8
Wiesława Bogutyn. *Inventory of technical appliances containing POPs,* 2002.

GF-POL-INV-R9
Joanna Żołędziowska. *Inventory of POPs industrial residues,* 2002.

GF-POL-INV-R10
Andrzej Siłowiecki. *Inventory of pesticide and herbicide waste,* 2002.

GF-POL-INV-R11
Wiesław Kołsut. *Chemical substances and preparations. Preliminary inventory of past production, import and export*, 2002.

GF-POL-INV-R12
Michał Andrijewski. *Assessment of the registration system and turnover control of chemical substances and preparations covered by the Stockholm Convention,* 2002.

GF-POL-INV-R13
Mieczysław Borysiewicz. *POPs releases with wastewater, solid waste, industrial produce and food.* Institute of Environmental Protection, Regional Centre of Environmental Safety, 2002.

GF-POL-INV-R14
Jan A. Krajewski. *Basics of health risk assessment and health risk prognosis in result of exposure against POPs (HCB, PCDD/F, PCB),* 2002.

GF-POL-INV-R15
Ryszard Rolecki. *Toxicological character of POPs and pathways of their hazard to human beings*, 2002.

GF-POL-INV-R16
Wojciech Mniszek, Bożena Wołek. *Assessment of risk to human health and environment related to the presence of POPs (12 substances covered by the Stockholm Convention).* Institute of Occupational Medicine and Environmental Health in Sosnowiec, 2002

GF-POL-INV-R17
Wojciech Mniszek, Bożena Wołek. *Review and evaluation of research and development activity results and publications concerning impacts of POPs on health and environment, particularly in the Upper Silesia.* Institute of Occupational Medicine and Environmental Health in Sosnowiec, 2002

GF-POL-INV-R18
Joanna Strużewska, Iwona Kargulewicz. *The research and development capacities related to POPs covered by the Stockholm Convention,* 2002.

GF-POL-INV-R19

Bogusław Dębski, Krzysztof Olendrzyński. *Preliminary assessment of the monitoring capacity related to POPs*, 2002.

GF-POL-INV-R20
Bogusław Dębski. *Legal regulations concerning POPs in the air*, 2002.

GF-POL-INV-R21
Adam Grochowalski. *Report on inter-laboratory comparison of dioxins, PCBs and HCB testing methods.* University of Technology in Kraków, Department of Chemical Engineering and Technology, Institute of Inorganic Chemistry and Technology, Laboratory of the Trace Analyses Team, 2002.

GF-POL-INV-R22
Elżbieta Niemirycz (head), Joanna Gozdek, Anna Kaczmarczyk, Hanna Tyszkiewicz. *Anthropogenic organic substances: origin, distribution and effects in bottom sediments of the Włocławek Reservoir.* Institute of Meteorology and Water Management, Maritime Branch, Division of Coastal Drainage Water Protection, 2002

GF-POL-INV-R23
Wiesława Bogutyn. *Results of PCBs inventories*, 2003.

Reports prepared for the Inception Workshop, commencing the GF/POL/04/001 Project on "Implementation of the Stockholm Convention" (Warsaw, 21-22 March 2002)

GF/POL/SEM.1/R.1
Adam Grochowalski. *Emission and concentration measurements of polychlorinated dibenzodioxins, dibenzofurans and biphenyls.* University of Technology in Kraków, 2002.

GF/POL/SEM.1/R.2
Krzysztof Olendrzyński, Iwona Kargulewicz. *The national POPs air emission inventory.* Institute of Environmental Protection, 2002.

GF/POL/SEM.1/R.3
Wiesława Bogutyn. *Issues concerning elimination of PCBs from the Polish economy.* Ministry of Economy, 2002.

GF/POL/SEM.1/R.4
Wiesław Kołsut. *Persistent organic pollutant emission reduction methods with particular consideration of industrial processes.* Institute of Environmental Protection, 2002.

GF/POL/SEM.1/R.5
Elżbieta Niemirycz. *Hazardous chemical substances of anthropogenic origin in the Polish surface waters Institute of Meteorology and Water Management*, 2002.

GF/POL/SEM.1/R.6
Krzysztof Czarnomski. *Hazardous waste and the requirements of the Stockholm Convention.* Institute of Environmental Protection, 2002.

GF/POL/SEM.1/R.7
Jerzy Majka. *Trade control of hazardous substances in Poland.* Bureau of Chemical Substances and Preparations, 2002.

GF/POL/SEM.1/R.8
Andrzej Siłowiecki. *Pesticide control system in Poland and the problem of elimination of pesticide landfills* Institute of Environmental Protection, 2002.

GF/POL/SEM.1/R.9
Paweł Głuszyński. *Investigations of human milk for the presence of substances classified as POPs.* Waste Prevention Association "3R", 2002.

Selected presentations prepared for the Validation Workshop (Warsaw 26 May 2003)

GF/POL/SEM.3/R.1
Wiesław Kołsut. *Results of production, import and export inventories of POPs covered by the Stockholm Convention.* GF-POL-SEM3-R1.

GF/POL/SEM.3/R.2
Elżbieta Niemirycz. *State of the aquatic environmental pollution by POPs in Poland.* GF-POL-SEM3-R2.

GF/POL/SEM.3/R.3
Jan Krajewski. *Assessment of health hazards connected with the presence of some POPs (HCB, PCB and PCDD/F) in Poland.* GF-POL-SEM3-R3.

GF/POL/SEM.3/R.4
Maciej Sadowski. *Assessment of the situation concerning POPs issues of the Stockholm Convention in Poland.* GF-POL-SEM3-R4.

GF/POL/SEM.3/R.6
Krzysztof Olendrzyński, Iwona Kargulewicz, Wiesław Kołsut, Jacek Skośkiewicz, Bogusław Dębski, Adam Grochowalski. *Emissions and releases of POPs into air and other media of environment.* GF-POL-SEM3-R6.

GF/POL/SEM.3/R.8
Krzysztof Czarnomski. *Priorities in POPs management.* GF-POL-SEM3-R8.

B. SIGNIFICANT DOMESTIC REPORTS

- *Evaluation of the state of production and use of plant protection chemicals in the context of environmental protection*. State Environmental Protection Inspection, Warsaw 1984.
- Rutkowski M.: *Development of a system preventing PCB environmental contamination in Poland.* Wrocław University of Technology, Institute of Petroleum and Coal Chemistry and Technology, 1997.
- *Programme of the State Environmental Monitoring for 1998–2002*. Biblioteka Monitoringu Środowiska, Warsaw 1998.
- Michna W.: *Report on monitoring investigations on quality of soil, plants, farm and food products in 1999*. Council for the Monitoring of Soil, Plants, Farm and Food Products. Ministry of Agriculture and Rural Development, Warsaw, Poland.
- Michna W., Szteke B. (ed.): *Report on monitoring investigations on quality of soil, plants, farm and food products in 2000.* Council for the Monitoring of Soil, Plants, Farm and Food Products. Ministry of Agriculture and Rural Development, Warsaw, Poland.
- *Report on the state of the environment in the Kujawsko-Pomorskie Voivodeship in 1999.* Voivodeship Environmental Protection Inspection, Bydgoszcz 2000.
- *Report on the state of the environment in the Małopolskie Voivodeship in 1999*. Voivodeship Environmental Protection Inspection, Kraków 2000.
- Grochowalski A.: *Studies on determination of PCDDs, PCDFs and PCBs.* Monografia nr 272, Zeszyty Naukowe Politechniki Krakowskiej, Kraków 2000.
- *Directives of the Chief Veterinarian on permissible levels of PCB in milk and milk products, meat and meat products, eggs and egg products, animal feeds and their additives of animal origin*. Warsaw 2000.
- *Third report for the Conference of the Parties to the United Nations Framework Convention on Climate Change.* Institute of Environmental Protection. Republic of Poland, Warsaw 2001.
- *Inventory of Dioxin and Furan Releases in Poland, DANCEE-Danish Cooperation for Environment in Eastern Europe.* Ministry of the Environment, Poland 2002.
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C. INTERNATIONAL REPORTS

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- *Environmental Health Criteria: Risk assessment of human health exposed to chemical substances; determination of standard indicators identified on health criteria.* Vol. 170, WHO, Geneva 1994 (translation into Polish language, Institute of Occupational Medicine, Łódź 1998).
- *Principles for the Assessment of Risks to Human Health from Exposure to Chemicals.* IPCS, Environmental Health Criteria No. 210. World Health Organisation, Geneva, 1999.
- *Survey of Currently Available Non-Incineration PCB Destruction Technologies.* UNEP Chemicals, 2000
- *Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases.* UNEP Chemicals, 2001.
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- *Joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook.* CORINAIR: Third Edition. Copenhagen, European Environment Agency, 2001.
- *World Bank: Guidance for Developing a National Implementation Plan for the Stockholm Convention* (draft). UNEP, 2003.

ANNEX 6. LIST OF CONTACT INSTITUTIONS AND ORGANISATIONS INVOLVED IN POPs – RELATED ISSUES

MINISTRIES	Chief Command, State Fire Service Podchorążych 38, 00-914 Warsaw Tel: (+48 22) 532 39 12; Fax (+48 22) 523 31 01
Ministry of Environment Wawelska 52/54, 00-922 Warsaw Tel. (+48 22) 579 25 63; Fax (+48 22) 579 22 63	***FINANCING INSTITUTIONS***
Ministry of Finance Świętokrzyska 12, 00-916 Warsaw Tel. (+48 22) 694 47 20; Fax (+48 22) 694 56 08	EcoFund Foundation Bracka 4; 00-502 Warszawa Tel. (+48 22) 628 98 53; Fax (+48 22) 628 50 82
Ministry of Economy, Labour and Social Policy Trzech Krzyży 3/5, 00-507 Warsaw Tel. (+48 22) 693 54 91; Fax (+48 22) 693 40 32	UNDP, GEF Small Grants Scheme UN Centre P.O. Box 1 Al. Niepodległości 186; 00-608 Warszawa Tel. (+48 22) 825 92 45; Fax (+48 22) 825 49 58
Ministry of Infrastructure Chałubińskiego 4/6, 00-928 Warsaw Tel. (+48 22) 630 13 32; Fax (+48 22) 630 13 30	National Fund for Environmental Protection and Water Management Konstruktorska 3a, 02-673 Warsaw Tel. (+48 22) 849 00 80; Fax (+48 22) 849 72 72
Ministry of National Defence Klonowa 1, 00-909 Warsaw Tel. (+48 22) 687 42 50; Fax (+48 22) 687 40 53	Voivodeship's Fund for Environmental Protection and Water Management (Dolnośląskie Voivodeship) Traugutta 1/7, 50-449 Wrocław Tel. (+48 71) 343 95 88; Fax (+48 71) 343 95 91
Ministry of Agriculture and Rural Development Wspólna 30, 00-930 Warsaw Tel. (+48 22) 623 21 53; Fax (+48 22) 628 87 84	Voivodeship's Fund for Environmental Protection and Water Management (Kujawsko-Pomorskie Voivodeship) Szosa Chełmińska 28, 87-100 Toruń Tel. (+48 56) 655 42 81 to 85; Fax (+48 56) 655 42 86
Ministry of Foreign Affairs; J. Ch. Szucha Ave. 23, 00-580 Warsaw Tel. (+48 22) 523 91 15; Fax (+48 22) 621 02 17	Voivodeship's Fund for Environmental Protection and Water Management (Lubelskie Voivodeship) Spokojna 7, 20-074 Lublin Tel. (+48 81) 74 24 648; Fax (+48 81) 74 24 649
Ministry of Environment Wawelska 52/54, 00-922 Warsaw Tel. (+48 22) 579 25 63; Fax (+48 22) 579 22 63	Voivodeship's Fund for Environmental Protection and Water Management (Lubuskie Voivodeship) Kożuchowska 4, 65-364 Zielona Góra Tel. (+48 68) 320 64 17
INSPECTIONS AND SERVICES	Voivodeship's Fund for Environmental Protection and Water Management (Łódź Voivodeship) Łąkowa 11, 90-562 Łódź Tel. (+48 42) 637 14 61; Fax (+48 42) 630 03 09
Bureau for Chemical Substances and Preparations Św. Teresy 8, 91-348 Łódź Tel. (+48 42) 631 46 81; Fax (+48 42) 63 14 681	
Chief Inspectorate of Plant Protection Wspólna 30, 00-930 Warsaw Tel. (+48 22) 623 23 54; Fax (+48 22) 626 80 86	Voivodeship's Fund for Environmental Protection and Water Management (Małopolskie Voivodeship) Kanonicza 12, 31-002 Kraków Tel. (+48 12) 422 94 90; Fax (+48 12) 422 30 46
Chief Environmental Protection Inspectorate Wawelska 52/54, 00-922 Warsaw Tel. (+48 22) 579 23 84	Voivodeship's Fund for Environmental Protection and Water Management (Mazowieckie Voivodeship) Wałbrzyska 3/5, 02-739 Warsaw Tel. (+48 22) 645 33 80; Fax (+48 22) 645 33 90
Chief Labour Inspectorate Krucza 38/42, 00-926 Warsaw Tel. (+48 22) 661 91 55	
Chief Sanitary Inspectorate Długa 38/40, 00-238 Warsaw Tel. (+48 22) 635 45 81; Fax (+48 22) 635 61 94	Voivodeship's Fund for Environmental Protection and Water Management (Opolskie Voivodeship) Krakowska 53, 45-018 Opole Tel. (+48 77) 453 76 11; Fax (+48 77) 453 76 11

Voivodeship's Fund for Environmental Protection and Water Management (Podkarpackie Voivodeship) Szopena 51, 35-055 Rzeszów Tel. (+48 17) 852 06 00; Fax (+48 17) 852 23 44	Voivodeship Environmental Protection Inspectorate, Laboratory Rząsawska 24/28, 42-200 Częstochowa Tel. (+48 34) 364 35 12; Fax (+48 34) 360 42 80
Voivodeship's Fund for Environmental Protection and Water Management (Podlaskie Voivodeship) Św. Rocha 5, 15-879 Białystok Tel. (+48 85) 746 02 41; Fax (+48 85) 746 01 66	Voivodeship Environmental Protection Inspectorate, Laboratory 20 078 Lublin, Obywatelska 13 Tel. (+48 81) 718 62 00; Fax (+48 81) 718 62 55
Voivodeship's Fund for Environmental Protection and Water Management (Pomorskie Voivodeship) Straganiarska 24, 80- 837 Gdańsk Tel. (+48 58) 305 56 31; Fax (+48 58) 301 91 92	Voivodeship Environmental Protection Inspectorate, Laboratory Plac Szczepański 5, 31-011 Kraków Tel. (+48 12) 421 09 38; Fax (+48 12) 422 36 12
Voivodeship's Fund for Environmental Protection and Water Management (Śląskie Voivodeship) Plebiscytowa 19, 40- 035 Katowice Tel. (+48 32) 251 80 71; Fax (+48 32) 251 04 06	Voivodeship Environmental Protection Inspectorate, Laboratory Langiewicza 26, 35-101 Rzeszów Tel. (+48 17) 854 36 83; Fax (+48 17) 850 53 77
Voivodeship's Fund for Environmental Protection and Water Management (Świętokrzyskie Voivodeship) Paderewskiego 20, 25-004 Kielce Tel. (+48 41) 366 15 12; Fax (+48 41) 366 09 05	Voivodeship Environmental Protection Inspectorate, Laboratory Ciołkowskiego 2/3, 15-264 Białystok Tel./ Fax (+48 85) 742 53 78
Voivodeship's Fund for Environmental Protection and Water Management (Warmińsko-Mazurskie Voivodeship) Świętej Barbary 9, 10-026 Olsztyn Tel. (+48 89) 535 24 59; Fax (+48 89) 535 29 10	Voivodeship Environmental Protection Inspectorate, Laboratory Czarna Rola 4, 61-625 Poznań Tel. (+48 61) 821 92 02; Fax (+48 61) 820 30 53
Voivodeship's Fund for Environmental Protection and Water Management (Wielkopolskie Voivodeship) Północna 6, 61-719 Poznań Tel. (+48 61) 855 26 21	Voivodeship Environmental Protection Inspectorate, Konin Branch, Laboratory Wyszyńskiego 3 A, 62-510 Konin Tel. (+48 63) 242 56 86; Fax (+48 63) 242 23 47
Voivodeship's Fund for Environmental Protection and Water Management (Zachodnio-Pomorskie Voivodeship) Solskiego 3, 71-323 Szczecin Tel. (+48 91) 486 15 56; Fax (+48 91) 486 15 57 ***LABORATORIES, PERFORMING POPS DETERMINATION***	Voivodeship Environmental Protection Inspectorate, Kalisz Branch, Laboratory Piwonicka 19, 62-800 Kalisz tel. (+48 62) 764 63 30; Fax (+48 62) 764 63 32
Voivodeship Environmental Protection Inspectorate, Laboratory Sienkiewicza 32, 50-349 Wrocław Tel. (+48 71) 372 13 06; Fax (+48 71) 32 21 617	Voivodeship Environmental Protection Inspectorate, Piła Branch, Laboratory Motylewska 5a, 64-920 Piła tel. (+48 67) 212 23 12; Fax (+48 67) 212 72 35
Voivodeship Environmental Protection Inspectorate, Laboratory Piotra Skargi 2, 85-018 Bydgoszcz Tel. (+48 52) 22 17 44; Fax (+48 52) 27 05 63	Voivodeship Environmental Protection Inspectorate, Leszno Branch, Laboratory 17 Stycznia 4, 64-100 Leszno tel. (+48 65) 529 58 56; Fax (+48 65) 529 48 41

Voivodeship Environmental Protection Inspectorate, Laboratory Wały Chrobrego 4, 70-502 Szczecin Tel. (+48 91) 430 37 25; Fax (+48 91) 434 05 54	Laboratory of the Institute of Ecology of Industrialised Areas, Kossutha 6, 40-832 Katowice Tel. (+48 32) 254 60 31; Fax (+48 32) 254 17 17
Voivodeship Environmental Protection Inspectorate, Laboratory IX Wieków Kielc Ave. 3, 25-516 Kielce Tel. (+48 41) 344 49 72; Fax (+48 41) 344 55 34	Laboratory of the Institute of Meteorology and Water Management, Podleśna 61, 01-673 Warsaw Tel. (+48 22) 834 18 51; Fax (+48 22) 834 18 01
Voivodeship Environmental Protection Inspectorate, Laboratory 1 go Maja 13, 10-117 Olsztyn Tel. (+48 89) 527 23 82; Fax (+48 89) 527 32 84	Department of Coastal Belt Water Protection, Institute of Meteorology and Water Management Jaśkowa Dolina 29, 80-286 Gdańsk Tel. (+48 58) 341 20 79; Fax (+48 58) 341 20 78
Voivodeship Environmental Protection Inspectorate, Bielsko Branch, Laboratory Partyzantów 117, 43-300 Bielsko Biała Tel./Fax (+48 33) 812 49 30	Water Quality Monitoring Section, Institute of Meteorology and Water Management, Wrocław Branch Parkowa 30, 51-616 Wrocław Tel. (+48 71) 320 01 00
Voivodeship Sanitary and Epidemiological Station, Laboratory Legionowa 8, 15-009 Białystok Tel. (+48 85) 732 60 11; Fax (+48 85) 732 70 22	Laboratory of the State Geological Institute Rakowiecka 4, 00-975 Warsaw Tel. (+48 22) 849 53 51; Fax (+48 22) 849 84 90
Voivodeship Sanitary and Epidemiological Station, Laboratory Mickiewicza 12b, 66-400 Gorzów Wlkp. Tel. (+48 95) 722 60 57; Fax (+48 95) 722 46 52	Laboratory of the State Hygiene Research and Development Institute Chocimska 24, 00-971 Warsaw Tel. (+48 22) 849 40 51; Fax (+48 22) 849 74 84
Voivodeship Sanitary and Epidemiological Station, Laboratory Jagiellońska 68, 25-516 Kielce Tel. (+48 41) 345 23 64; 345 18 73	Laboratory of the Institute of Plant Protection Miczurina 20 a, 60-318 Poznań Tel. (+48 61) 867 57 13; Fax (+48 61) 867 11 75
Voivodeship Sanitary and Epidemiological Station, Laboratory Prądnicka 76, 31-202 Kraków Tel. (+48 12) 616 20 91; Fax (+48 12) 416 20 93	Laboratory of the Institute of Chemical Coal Processing Zamkowa 1, 41-803 Zabrze Tel. (+48 32) 271 00 41; Fax (+48 32) 271 08 09
Voivodeship Sanitary and Epidemiological Station, Laboratory Żołnierska 16, 10-560 Olsztyn Tel. (+48 89) 527 95 00; Fax (+48 89) 527 97 88	Laboratory of Environmental Protection of the Pulp and Paper Institute Skłodowskiej Curie 19/27, 90-570 Łódź, Tel. (+48 42) 638 03 51; Fax (+48 42) 636 88 31
Voivodeship Sanitary and Epidemiological Station, Laboratory Noskowskiego 23, 61-705 Poznań Tel. (+48 61) 854 48 02; 828 93 57; Fax (+48 61) 852 50 03	Laboratory of the Institute of Environmental Protection Krucza 5/11, 00-548 Warsaw Tel. (+48 22) 625 10 05; Fax (+48 22) 629 52 63
Voivodeship Sanitary and Epidemiological Station, Laboratory Libelta 36, 61-705 Poznań Tel. (+48 61) 854 48 18; Fax (+48 61) 854 48 12	Laboratory of the Institute Chemistry and Technology of Petroleum and Coal Wrocław Technical Institute Gdańska 7/9, 50-344 Wrocław Tel. (+48 71) 320 65 07; Fax (+48 71) 322 15 80
Voivodeship Sanitary and Epidemiological Station, Laboratory Żelazna 79, 00-875 Warsaw Tel. (+48 22) 620 90 04; Fax (+48 22) 620 37 19	Laboratory of the Department of Chemistry of the Gdańsk University of Technology Narutowicza 18, 80-952 Gdańsk Tel. (+48 58) 345 03 72; Fax (+48 58) 347 03 57
Voivodeship Sanitary and Epidemiological Station, Laboratory Dębinki 4, 80-211 Gdańsk Tel. (+48 58) 344 73 00; Fax (+48 58) 302 32 53	Chair Inorganic and Analytical Chemistry, K. Marcinkowski Academy of Medicine Grunwaldzka 6, 60-780 Poznań Tel. (+48 61) 865 95 66

Laboratory of the Marine Fisheries Institute Kołłątaja 1, 81-332 Gdynia Tel. (+48 58) 620 28 31	Institute of Meteorology and Water Management Podleśna 61, 01-673 Warsaw Tel. (+48 22) 835 49 26; Fax (+48 22) 835 49 26
Laboratory of Military Institute of Chemistry and Radiometry gen. A. Chruściela 105, 00-910 Warsaw Tel. (+48 22) 516 99 35; Fax (+48 22) 673 58 51	Marine Institute Długi Targ 41/42, 80-830 Gdańsk Tel. (+48 58) 552 00 93; Fax (+48 58) 301 35 13
RESEARCH DEVELOPMENT INSTITUTIONS Economic University in Cracow, Rakowicka 27, 31-510 Kraków Tel. (+12) 293 53 32; Fax (+12) 293 50 50	Institute of Plant Protection Miczurina 20a, 60-318 Poznań Tel. (+48 61) 867 57 13; Fax (+48 61) 867 11 75
K. Marcinkowski Academy of Medicine Chair Inorganic and Analytical Chemistry, Grunwaldzka 6, 60-780 Poznań Tel. (+48 61) 865 95 66	Institute of Environmental Protection Krucza 5/11, 00-548 Warsaw Tel. (+48 22) 629 92 56; Fax (+48 22) 629 41 35
Central Institute for Labour Protection – National Research Institute Czerniakowska 16, 00-701 Warsaw Tel. (+48 22) 623 46 81; Fax (+48 22) 623 36 95	Institute of Organic Industry Annopol 6, 03-236 Warsaw Tel. (+48 22) 811 12 31 ext. 288 Fax (+48 22) 811 07 99
Pulp and Paper Institute Skłodowskiej Curie 19/27, 90-570 Łódź Tel. (+48 42) 638 03 51; Fax (+48 42) 638 03 79	Institute of Timber Technology Winiarska 1, 60-654 Poznań Tel. (+48 61) 849 24 00; Fax (+48 61) 822 43 72
Institute of Industrial Chemistry Rydygiera 8, 01-793 Warsaw Tel. (+48 22) 633 92 91; Fax (+48 22) 633 92 91	State Geological Institute Rakowiecka 4, 00-975 Warsaw Tel. (+48 22) 849 53 51; Fax (+48 22) 849 53 42
Institute of Chemical Coal Processing Zamkowa 1, 41-803 Zabrze Tel. (+48 32) 271 00 41; Fax (+48 32) 271 08 09	National Institute of Hygiene Chocimska 24, 00-791 Warsaw Tel. (+48 22) 849 33 32
Institute of Building Mechanisation and Rock Mining, Field Branch in Katowice "Centre of Waste Management" Barbary 21 a, 40-053 Katowice Tel. (+48 32) 271 00 41; Fax (+48 32) 251 75 91	Mining and Metallurgical University Reymonta 23, 30-059 Kraków Tel. (+48 12) 617 27 56; Fax (+48 12) 633 63 48
The Nofer Institute of Occupational Medicine Św. Teresy od Dzieciątka Jezus 8, 90-950 Łódź, P.O. Box 199 Tel. (+48 42) 631 48 43; Fax (+48 42) 631 45 72	Kraków University of Technology Warszawska 24, 31 155 Kraków Tel. (+48 12) 628 22 01; Fax (+48 12) 628 20 36
Institute of Labour Medicine and Environmental Health Kościelna 13, 41-200 Sosnowiec Tel. (+48 32) 266 08 85 to 297 Fax (+48 32) 266 11 24	Łódź University of Technology Wólczańska 175, 90-924 Łódź Tel. (+48 42) 631 37 00; Fax (+48 42) 636 56 63
Institute of Non Ferrous Metals Sowińskiego 5, 44-100 Gliwice Tel. (+48 32) 238 03 29; Fax (+48 32) 231 69 33	Warsaw University of Technology Nowowiejska 20, 00-653 Warsaw Tel. (+48 22) 628 59 85; Fax (+48 22) 629 29 62
Institute of Ferrous Metallurgy K. Miarki 12/14, 44-100 Gliwice Tel. (+48 32) 234 51 20; Fax (+48 32) 234 53 00	Wrocław University of Technology Gdańska 7/9, 50-344 Wrocław Tel. (+48 71) 320 64 34; Fax (+48 71) 322 15 80

Military Institute of Chemistry and Radiometry Gen. Chruściela 105, 00-910 Warsaw Tel. (+48 22) 516 99 36; Fax (+48 22) 673 58 51	Centre of Ecological Law Uniwersytecka 1, 50-951 Wrocław Tel. (+48 71) 341 02 34
NON–GOVERNMENTAL ORGANIZATIONS (NGOs)	Lowersilesian Fundation of Sustainable Białoskórnicza 26, 50-134 Wrocław Tel. (+48 71) 343 08 49; Fax (+48 71) 343 60 35
Consumers Federation, National Council Powstańców Warszawy 1, 00-030 Warsaw Tel. (+48 22) 827 68 91	
Nature Protection League Tamka 37/2, 00-355 Warsaw Tel. (+48 22) 828 81 71; Fax (+48 22) 828 65 80	***CONSULTING COMPANIES***
	PROEKO Co. Ltd. Environmental Protection Consultants Tamka 16, 00-349 Warsaw Tel. (+48 22) 827 59 00; Fax (+48 22) 827 58 57
National Foundation of Environmental Protection Erazma Ciołka 13, 01-445 Warsaw Tel. (+48 22) 877 23 59; Fax (+48 22) 877 23 59	CHEMEKO Expert and Designing Services Enterprise, Co. Ltd. Toruńska 222, 87-805 Włocławek Tel. (+48 54) 237 35 06; Fax (+48 54) 237 24 12
Waste Prevention Association “3R” P.O. Box 54, 30 961 Kraków 5 Tel./Fax (+48 12) 421 09 09	***COMPANIES DEALING WITH WASTE CONTAINING POPS***
	TIGRET Co. Ltd. Rumuńska 29B, 05-816 Michałowice Tel. (+48 22) 753 02 62; Fax (+48 22) 753 03 94
Polish Chamber of Chemical Industry Association of Employers Czackiego 15/17, 00-043 Warsaw Tel. (+48 22) 828 75 06; Fax (+48 22) 826 73 39	MALEX Waste Treatment Plant Wernera 23, 91-169 Łódź Tel. (+48 42) 714 02 78; Fax (+48 42) 714 01 49
Polish Ecological Club Plebiscytowa 19, 40-035 Katowice Tel. (+48 32) 251 74 98; Fax (+48 32) 251 75 90	Chemicals Works ANWIL (hazardous waste incineration plant) Toruńska 222, 87-805 Włocławek Tel. (+54) 236 30 91; Fax; (+54) 236 19 83
Secretariat of “Responsible Care” Programme in Poland Toruńska 222, 87-805 Włocławek Tel. (+48 54) 237 21 76; Fax (+48 54) 237 24 12	Chemical Works ROKITA(hazardous waste incineration plant) Sienkiewicza 4, 56-120 Brzeg Dolny Tel. (+48 71) 319 25 12; Fax (+48 71) 319 25 70