Waste Prevention Association „3R”

Persistent Organic Pollutants

in Poland

Study on Human Breast Milk

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Introduction

On 23rd May of 2001, in Stockholm, Poland, together with 113 other countries, signed an international Convention on Persistent Organic Pollutants (POPs).[1] In this way, our government has committed itself to elaborate and implement – in the shortest possible time – a national program for the identification and elimination of the sources of POPs. This commitment had also been made before in Poland's *National Environmental Policy ("Polityka Ekologiczna Państwa")*[2] and in the *National Program of Preparation for Membership in the EU*.

The actions taken so far by the government agencies towards protecting the society from the consequences of exposure to POPs need to be deemed inadequate. This concerns both access to information on the potential sources of pollutants and the financing of studies and investment projects aimed at controlling their release into the environment. The area those problems are the most conspicuous in is minimizing waste production and their safe disposal in the facilities that themselves are not another source of persistent organic pollutants.

The Waste Prevention Association (WPA) has demonstrated in its previous report that Poland is at the top of a shameful list of countries that are still struggling with their huge stocks of expired pesticides and equipment containing polichlorinated biphenyls (PCBs).[3] As for other sources of POPs, no reliable information is available – this concerns e.g. hexachlorobenzene.

It is practically impossible to obtain data on emissions from waste incineration plants, which are one of the main sources of persistent organic compounds.

In Poland, several studies were carried out of population's exposure to PCBs and pesticides [4, 6, 7]. Besides two measurements limited to one location, of which only one (performed in late 1980s) meets international standards, the content of dioxins in human breast milk was never analysed on a larger scale.

Therefore, WPA has undertaken to conduct one of the first studies in Poland to be carried out in several different regions of this country, while covering most of the compounds numbered among persistent organic pollutants. Our research can be used as material for further analyses, and first of all – for the taking of reference measurements in non-urbanized areas or where industrial plants with a different type of production are located.

Study on Human Breast Milk

Selection of towns

The studies have been conducted in three towns in which Poland's largest chemical works to use halogenated compounds for production purposes, as well as plants incinerating industrial and medical wastes, are located in the towns of Brzeg Dolny, Tarnów, and Włocławek. Large chemical works complexes can be still found – or could be found until recently, like that in Tarnów – on the Polish official *List of the 80 largest polluters on the national scale*. In those towns, no analyses were carried out before of the level of population's exposure to compounds numbered among persistent organic pollutants.

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[1] Secretariat of the Stockholm Convention: http://www.chem.unep.ch/sc Information in Polish, including a report on persistent organic pollutants in Poland, can be found on WPA web pages: http://www.otzo.most.org.pl/niebezpieczne

[2] Chapter 1.4. Ekologizacja polityk sektorowych (Greening of sectoral policies), section 35, poprawa jakości powietrza (air quality improvement). Warszawa, 2000.

[3] "Persistent Organic Pollutants in Poland", WPA, Kraków, 2001.

It should be emphasised, however, that these are not the only towns in which elevated concentrations of organochlorine substances can potentially occur in the environment.

Brzeg Dolny

The chemical works "Rokita" in Brzeg Dolny (Zakłady Chemiczne "Rokita" S.A.) were built by Germans in late 1930s, for the sake of production of military gases – tabun and sarin. After WW II, the plant started to specialize in the production of pesticides and polyurethane. The several hundred products of "Rokita" include e.g.: chlorine liquid and chlorine gas, sodium hypochlorite, chlorobenzene, ortho- and para-dichlorobenzene, monochloroacetic acid, trichloroethylene.

In 1980s, products of the Plant were analyzed for the presence of dioxin compounds. It was found out that a pentachlorophenol (PCP) - based wood preservative contained 1200 milligrams of dioxins per kilogram of the product, which is an extremely high concentration.[4] Dioxins were also determined in some herbicides manufactured by "Rokita", but already at lower concentrations – in 2,4-D at the level of 14.7 mg/kg, and in 2,4-DP – 24.9 mg/kg.[5]

An article published in 1992 contained information that over 20 000 tonnes of chlorinated wastes from pesticide production had been gathered on the premises of "Rokita". [6]

In mid-1990s, a waste incineration plant was built at "Rokita" in which both wastes from the ongoing production as well as those amassed in previous years are disposed of. The incineration plant also receives PCB wastes from third-party deliverers.

In spite of repeatedly renewed written and telephone requests for information on the incineration plant and emission measurements, WPA has never received any reply from "Rokita's" management.

According to the Institute of Meteorology and Water Management in Wrocław, the prevailing winds in Brzeg are western ones – the chemical works are located in the eastern part of the town, but at a short distance from housing developments.

Tarnów

75 years ago, in the western part of Tarnów, one of Poland's larger chemical complexes came into being: Zakłady Azotowe ("Nitrogen Works"). From the very beginning, its basic products were nitrogen fertilizers and chlorine products. In 1967, production of polyvinyl chloride was launched. Starting from 1971, for five years the works produced PCB.

In 1989, the factory released into the atmosphere 826 tonnes of vinyl chloride and 174 tonnes of hydrogen chloride. By the year 2000, when a PVC production line was put out of use, emissions of

[4] „Dioksyny - PCDDs. Groźne trucizny dla człowieka i środowiska przyrodniczego", Wydawnictwo AGH, Kraków, 1989.

[5] Tadeusz Górski, Tadeusz Syrowatka, *Zanieczyszczenia polichlorowanymi dwubenzofuranami (PCDFs) chlorofenoli i niektórych herbicydów produkcji krajowej*, „Rocznik PZH", 1984, 35, No. 5.

[6] Alphons A.C. Uijtewaal Amador, *Buried Pesticides Waste Hazard to Poland*, „Waste Management & Research", 10, 1992.

vinyl chloride remained at the constant level of 17 tonnes per year, whereas emissions of hydrogen chloride varied from 300 to 500 tonnes a year.

The "Azoty" works burn considerable amounts of halogenated process wastes in the heat and power generating plant attached to the factory. Dioxin emissions accompanying the burning of chlorinated wastes amounted to 0.12 ng-TEQ/Nm^3, and were relatively bigger in comparison with standard incineration plants, as the volume of flue gases amounted to 10^6 m^3/h.

In the eastern part of the town, by the Provincial Hospital, a medical waste incineration plant was built in 1999 with a capacity of 976 tonnes/year. Recently, construction was started of an incineration plant for the sludge from the municipal sewage treatment plant.

Just like in other towns, western winds prevail.

Włocławek

Since 1960s, Włocławek has been home to Poland's largest plant producing granulated PVC and PVC panels: Zakłady Azotowe "Anwil" S.A. Annually, the plant produces 200 thou. tonnes of polyvinyl chloride, systematically striving to achieve the capacity of 300 thousand tonnes. Anwil's products include, among other things, chlorine liquid, ammonia, as well as hydrochloric and nitric acid.

In late 1980s, the plant released into the atmosphere 198 tonnes of vinyl chloride per year. In 1990s, the emissions were reduced threefold, and recently – by a further 50%.

In 1998, an incinerating plant for gaseous and solid chlorinated wastes was put into operation on Anwil's premises. In. 1999, 13800 tons of gaseous wastes were burnt, 5900 tonnes of liquid wastes, and 4 tonnes of solid wastes. According to measurements taken, dioxin emissions are at the level of 0.04 ng-TEQ/Nm^3.

At present, the incineration plant is used also by an Anwil's company – Chemeko – for the commercial burning of hazardous waste generated by other enterprises. On its web pages, Chemeko encourages potential deliverers to dispose of halogenated wastes at a dumping price: 390 PLN (approx. US$ 97) per tonne.

Attached to Wojewódzki Szpital Zespolony (Provincial Integrated Hospital) is a medical waste incineration plant with a capacity of 275 tonnes/year.

The above mentioned plants are located in the western and north-western part of the town, from the side from which winds blow the most often (~45%).

Research Procedure

The study has been conducted in line with recommendations of the World Health Organization.

Milk samples were taken in September 2001 by qualified medical staff from 31 anonymous donors: 10 in Tarnów and in Włocławek each, and 11 in Brzeg Dolny. The donors had to meet the following criteria:

- had lived for at least 5 years in the town in which the study was being carried out, with a break of no longer than 6 months of continuous residence outside the town they lived in,
- their pregnancy period had had a normal progress,
- they were breastfeeding just one child,
- they were between 3rd and 7th week of lactation.

The material for investigation was taken on the whole territory of the identified towns, without limitation to the immediate neighborhood of the industrial plants.

Individual samples (50 ml) were mixed together (pooled), in order to obtain one for a given town. The human milk was subject to analysis in laboratories internationally certified for the testing of compounds numbered among persistent organic pollutants. The analysis of dioxins and furans was carried out in the Czech Republic by the company Axys Varilab, whereas polichlorinated biphenyls and pesticides were determined at the National Reference Center for Dioxin and Related Compounds in Slovakia.

Survey

An interview was held with each of the women. It was based on a standard WHO questionnaire, supplemented by WPA with a question on the contact of those surveyed with toxic substances (pesticides, halogenated compounds or others) in the workplace. The surveys have been summarised the table below:

	Brzeg Dolny	**Tarnów**	**Włocławek**
Average age of donors (years)	29	23	27
Average age of children (weeks)	5	3.7	4.5
Children's sex	5 girls 6 boys	6 girls 4 boys	8 girls 2 boys
Average weight of children (kg)	4.29	4.18	3.42
Medicines taken in the period of lactation	none	none	none
Exposure of donors to toxic substances in the workplace	none	none	none
Number of women who smoke	2 (from 2 to 6 cigarettes/day) 3 quit smoking	0	2 (from 6 to 10 cigarettes/day)

The diet of the women surveyed did not differ from the national average and from the average for the period of breast feeding. Mothers consumed 500 ml of milk with the average fat content up to 2.9% and bigger quantities of cheese, mainly of the low-fat varieties. On the other hand, they ate fish less frequently than once a week, and beef – less frequently than twice a week. In Włocławek, 60% of the surveyed excluded beef from their diet completely.

Results of Milk Analyses

The determined levels of POPs content in the women's milk have been collected in the table below. For the sake of simplicity, all values have been given in picograms per gram of fat (pg/g).

Congener / Substance	**TEQ WHO**	**Brzeg Dolny pg/g fat**	**Tarnów pg/g fat**	**Włocławek pg/g fat**
Dioxins and furans				
2,3,7,8 TeCDD	1	1,8	1,6	1,8

Congener / Substance	TEQ WHO	Brzeg Dolny pg/g fat	Tarnów pg/g fat	Włocławek pg/g fat
1,2,3,7,8 PeCDD	1	2,7	3,1	3,9
1,2,3,4,7,8 HxCDD	0,1	1,5	1,5	1,4
1,2,3,6,7,8 HxCDD	0,1	8,3	7,0	9,7
1,2,3,7,8,9 HxCDD	0,1	2,0	1,7	2,1
1,2,3,4,6,7,8 HpCDD	0,01	10,1	17,5	9,1
OCDD	0,0001	40,2	62,9	59,3
2,3,7,8 TeCDF	0,1	1,3	0,9	1,3
1,2,3,7,8 PeCDF	0,05	0,6	0,5	0,5
2,3,4,7,8 PeCDF	0,5	10,7	10,3	9,9
1,2,3,4,7,8 HxCDF	0,1	6,4	4,3	3,9
1,2,3,6,7,8 HxCDF	0,1	3,3	2,9	2,3
1,2,3,7,8,9 HxCDF	0,1	0	0	0
2,3,4,6,7,8 HxCDF	0,1	1,2	1,4	1,1
1,2,3,4,6,7,8 HpCDF	0,01	3,4	2,4	3,2
1,2,3,4,7,8,9 HpCDF	0,01	0,3	0,2	0,2
OCDF	0,0001	1,5	0,8	1,0
pg WHO-TEQ/g fat	**-**	**12,42**	**12,05**	**12,98**
Polichlorinated biphenyls				
PCB-28	-	950	1100	1070
PCB-52	-	< 120	< 120	< 120
PCB-101	-	650	290	90
PCB-105	0,0001	890	1270	950
PCB-118	0,0001	4940	6330	4930
PCB-138	-	17800	16000	15600
PCB-153	-	26400	24300	22000
PCB-156	0,0005	3300	2540	2610
PCB-157	0,0005	400	180	300
PCB-170	-	6090	4790	4540
PCB-180	-	15300	17000	12700
PCB-189	0,0001	60	< 50	< 50
pg WHO-TEQ/g fat	**-**	**2,44**	**2,12**	**2,05**
Sum of PCDDs/PCDFs and PCBs				
	-	**14,86**	**14,17**	**15,03**
Pesticides				
HCB	-	34900	31500	22600
alfa-HCH	-	< 80	< 80	< 80
beta-HCH	-	14980	18400	16500
gama-HCH	-	960	970	1120

Congener / Substance	TEQ WHO	Brzeg Dolny pg/g fat	Tarnów pg/g fat	Włocławek pg/g fat
p,p'-DDE	-	13200	6860	7300
p,p'-DDT	-	99800	50900	49900

Due to a shortage of funds, the following most toxic coplanar congeners of polichlorinated biphenyls have not been analysed in the material collected: 77, 81, 126, and 169. Thus, the actual toxicity level for PCBs will be much higher, by at least 30%. In line with the WHO procedure, the total TEQ of dioxins, furans and PCBs should be increased accordingly.

The value of daily intake of dioxins and PCBs from mother's milk by children has been calculated based on the formula of the US EPA [2]:

$$ADD_{infant} = \frac{C_{milk\ fat}\ f_3\ f_4\ IR_{milk}\ ED}{BW_{infant}\ AT}$$

where,

ADD_{infant}	=	Average daily dose to the infant (pg/kg-d)
$C_{milk\ fat}$	=	Concentration in milk fat (pg/g)
IR_{milk}	=	Ingestion rate of breast milk (kg/d)
f_3	=	Fraction of fat in breast milk
f_4	=	Fraction of ingested contaminant that is absorbed
ED	=	Exposure duration
BW_{infant}	=	Body weight of infant (kg)
AT	=	Averaging time (yr)

According to data from relevant publications [1, 2, 5] and the dietary history data obtained by way of an inquiry, the volume of daily consumption of milk by the children has been assumed to be 800 ml. Using this procedure, the following results have been obtained:

Substance	WHO Standard	Brzeg Dolny	Tarnów	Włocławek
PCDDs + PCDFs + PCBs pg WHO TEQ/kg of body weight/day	**1 - 4**	**90,48**	**86,74**	**93,79**

Taking into account the lowest safe intake of dioxins and PCBs, specified by the WHO at the level of 1 pg-TEQ/kg of body weight per day[7], the excesses are as high as over 90-fold.

Multiple excesses of the highest acceptable intake of toxic compounds have been found also in the case of DDT (calculated per product):

Substance	NDP[8]	Brzeg Dolny	Tarnów	Włocławek

[7] In April 2001, the Joint Expert Committee of FAO/WHO on Food Additives and Contaminants suggested establishing a new Tolerable Monthly Intake (PTMI) of dioxins and PCBs at the level of 70 pg-TEQ per kg of body weight. In practice, that means that with permanent exposure, the daily intake of dioxins cannot exceed 2 pg-TEQ per kg of body weight.

Substance	NDP[8]	Brzeg Dolny	Tarnów	Włocławek
HCB (mg/kg)	0,04	0,0012	0,0011	0,0008
Σ HCH (mg/kg)	0,005	0,0005	0,0007	0,0006
DDT: sum of p,p'-DDE and p,p'-DDT (mg/kg)	**0,01**	**0,052**	**0,027**	**0,029**

Without additional analyses, especially of the sources of origin of food, it is not possible to determine the reasons for differences between the content of DDT in Brzeg Dolny and in the other towns.

Summing-up

The determined concentrations of persistent organic pollutants exceed the domestic and world standards of health safety by many times. True, they are close to those found in other industrialised countries in early 1990s, but they differ considerably from the current concentrations [1, 5, 8, 10].

Considering the production profile of industrial plants located in the towns in which our investigations were conducted, they have been a source of POPs for many decades. During that period, consecutive generations received elevated intakes of most dangerous toxins. One can only suppose that in the past the level of contamination was even higher than today.

The exposure of the population, and especially children, to long-term high intakes of POPs results in irreversible genetic and immunological changes – increased incidence of various infections, cancer, and cardiovascular diseases.[9]

Thus, it is necessary to take quick steps in order to precisely identify the sources of POPs and eliminate them.

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[8] The highest acceptable level of pesticides in baby products (up to the age of 12 months), and small children (up to the age of 36 months), Ordinance of Ministry of Health (Dz. U. 1997 nr 43, poz. 273).

[9] Agencies that study the effects of dioxins on the human body assume in spite of all that breast feeding is more beneficial for the child's development. The negative effect of dioxins is caused first of all by the long-term exposure rather than by the elevated daily intake within a relatively short period of time.

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