

THE INDUSTRY OF THE GDAŃSK AGGLOMERATION AND THE ENVIRONMENTAL HAZARDS OF THE REGION

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As a result of the intensive industrialization process in Poland after World War II, there has been a huge devastation of environment.

In 1983, 27 areas of ecological hazard were established in Poland. One of them is the area consisting of the Gdańsk Bay, the Vistula Bay and the seaside terrains with the Gdańsk agglomeration, the Hel Peninsula and the Elbląg area. (*Figure 1*) The surface of this area is 3,219 km² with more than 1.1 million inhabitants. The cities and communes of this area are as follows:

- **cities:** Gdańsk, Gdynia, Sopot, Braniewo, Elbląg, Frombork, Hel, Jastarnia, Pruszcz Gdański, Puck, Reda, Rumia, Tolkmicko, Wejherowo, Władysławowo and Żukowo;
- **communes:** Braniewo, Cedry Wielkie, Elbląg, Frombork, Kolbudy Górne, Kosakowo, Krokowa, Milejowo, Pruszcz Gdański, Puck, Stegna, Sztutowo, Tolkmicko, Wejherowo and Żukowo.

The total surface of the ecological hazard areas in Poland is 35,220 km², which is 11.3% of the surface of the whole country. The Gdańsk hazard area covers 1% of the territory of Poland and 9.1% of the combined surface of the Polish ecological hazard areas.

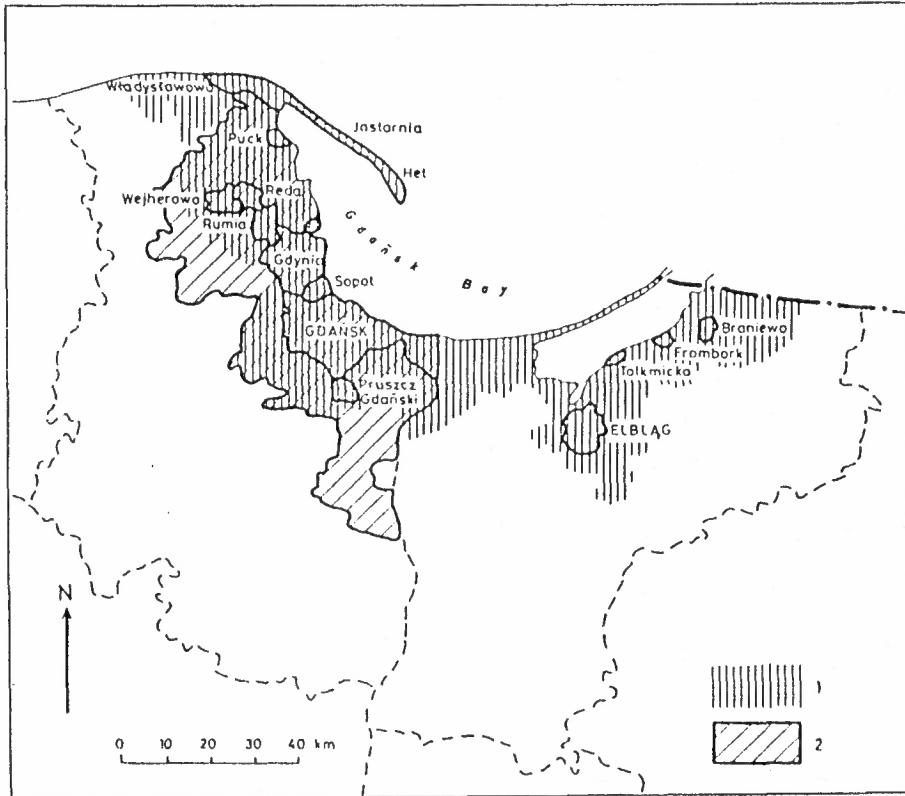
In 1985, 120 hectometres of industrial water pollution, 81,500 tons of industrial air pollution and 8,982,000 tons of solid waste were emitted in the Gdańsk voivodship. Most of this pollution, more than 80%, was produced in towns. (*Table 1*)

Pollution is an enormous problem in the Gdańsk area because of the region's functions (industry, tourism and recreation in the Baltic coastal area) and because of the high population density (190 persons per km²).

More than half (50.8%) of the surface of the Gdańsk ecological hazard area is occupied by the Gdańsk agglomeration with 987,300 inhabitants, which is 85.3% of the whole area's population. This agglomeration comprises the next cities:

Gdańsk, Gdynia, Sopot, Wejherowo, Luzino, Kosakowo, Szemud, Żukowo, Kolbudy, Pruszcz Gdański, Cedry Wielkie, Pszczółki, Tczew and Subkowy.

Figure 1
The Gdańsk agglomeration against the background of the ecological hazard area of Gdańsk



1 — ecological hazard area; 2 — Gdańsk agglomeration

In this agglomeration there are 365 industrial plants with more than 110,000 employees, comprising 2.5% of Poland's industrial earners. So the Gdańsk agglomeration is an area of industrial concentration and a source of environmental hazards.

The highest growth of pollution emission in this area occurred in the years 1975–1980. (Table 2) During this period, air pollution increased from 40,100 tons in 1975 to 86,600 tons in 1980, which consisted mainly of sulphur dioxide gas and fly-ash. In 1980 the extent of air pollution in the Gdańsk agglomeration was set at 3.8 tons per km² of industrial dust and 7.9 tons per km² of industrial gas. In the same period, as we noticed, the amount of industrial solid waste almost doubled: it increased from 4,492,500 tons in 1975 to 8,356,200 tons in 1980, which is now stored on this 207 ha area.

Table 1
Industrial pollution of environment in towns of the Gdańsk agglomeration, 1985

	Sewage flowing into surface waters and must be treated	Air pollution by dust and gases altogether	Accumulated solid waste	Surface of solid waste
	dam ³	1000 t	1000 t	ha
Voivodship total	27,094	93.8	11,228.1	203.0
Towns of the agglomeration of which				
Gdańsk	14,463	89.6	11,032.7	194.9
Gdynia	10,251	58.0	10,557.6	63.5
Pruszcz Gdański	3,167	29.6	421.1	129.3
Wejherowo	830	0.6	54.0	2.1
Sopot, Reda, Rumia	215	1.4	—	—
	—	—	—	—

Table 2
Dynamics of environmental pollution in the Gdańsk voivodship emitted by industry, 1975-1987

Year	Air pollution		Sewage flowing into surface waters, municipal sewerage and into the grund	Solid waste accumulated by the end of the year	Surface of solid waste storage yards
	Dust	Gases			
	t per year		million m ³ per year	1000 t	ha
1975	13,200	26,900	170,7	4,492.5	59.9
1980	27,900	58,700	124,9	8,356.2	207.0
1985	35,800	58,000	89,7	11,228.1	203.0
1987	41,350	74,607	108,1	13,036.8	208.0

It is difficult to speak about water pollution because many of the industrial plants in the Gdańsk area do not have legal permission for water emission, and therefore their emission of liquid waste is out of control, illegal and unmeasured.

Of course, sewage poses a serious problem in the agglomeration. This is the place where the River Vistula with a few small tributaries reaches the Baltic Sea. The River Vistula is the biggest receiver of waste water in Poland.

According to the information obtained from the Centre of Research and Control of Environment in Gdańsk, in 1984 about 113,514,5 dam³ of sewage per day was flowing into the Gdańsk Bay with nearly 4,000 tons of organic substances and 400 tons of nitrates and phosphates a day. This amount of entire sewage originated from the waste water arriving from:

1. Industrial-harbour complex of Gdynia:
78.8 dam³ per day
2. Sopot-Gdańsk urban complex:
162.6 dam³ per day
3. Industrial-harbour complex of Gdańsk:
110.2 dam³ per day
4. Wejherowo-Gdynia urban complex:
50.9 dam³ per day
5. Liquid waste of the Rivers Motława and Reda:
1,656.0 dam³ per day
6. The water of the River Vistula from outside of the Gdańsk voivodship:
111,456.0 dam³ per day

As it can be concluded from the above, more than 98% of the waste water is not emitted in the Gdańsk area.

The condition of environment in the Gdańsk agglomeration is mainly influenced by 16 industrial plants. The complex of five thermal-electric power stations is located there. Two of them can be found in Gdańsk, and three in Gdynia—altogether occupying a surface of 202.7 ha. There are three big chemical plants in Gdańsk: a plant of phosphatic fertilizers (occupying a 51.3 ha territory), a refinery (on a surface of 336.4 ha) and a sulphur shipping agency (with a 5 ha area). Furthermore, much pollution is caused by the four shipyards—especially the Gdańsk shipyard (135.7 ha) —, the cement plant in Wejherowo, two fat industry plants in Gdańsk and Gdynia, a gas engineering plant in Gdańsk and a sugar factory in Pruszcz Gdański. In 1985, these plants emitted more than 77% of the total industrial sewage, 95% of the air pollution and 99.6% of the solid waste for this area. At this point the amount of pollution reveals the same upward tendency. (Table 3)

There are six sewage works in the area of the Gdańsk agglomeration: three of them are based on mechanical treatment and three on mechanical-biological treatment. They treat industrial sewage as well. In 1986, the load factor of these plants was more than 100%. The worst situation is characteristic of Gdynia where only one mechanical-biological treatment plant operates—with more than a 194% load factor. (Table 4)

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Table 3
Emission of industrial pollution in the Gdansk agglomeration from plants with the highest environmental hazards, 1982-1987

Plant	Surface of plant m ²	1982				1985				1987			
		Number of employees	Pollution		Number of employees	Pollution		Number of employees	Pollution		Number of employees	Pollution	
			Dust and gases t	Solid waste accumulated 1000 t		Sewage flowing into surface waters dam ³	Dust and gases t		Solid waste accumulated 1000 t	Sewage flowing into surface waters dam ³		Dust and gases t	Solid waste accumulated 1000 t
Complex of thermal-electric power stations of which	2,027,412	1,887	45,688	839.4	2,185	34,815	63,857	1,758.7	159.7	2,142	52,239	71,164	2,489.9
EC Gdańsk II	585,951	—	16,740	733.1	—	26,380	33,091	1,303.9	30.4	—	40,618	37,629	1,791.7
EC Ofiarna Gdańsk	29,221	—	1,911	—	—	2,997	2,230	—	—	—	8,382	2,681	—
EC Gdynia II	21,430	—	7,012	—	—	2,690	8,525	23.4	—	—	1,624	8,267	—
EC Gdynia III	1,355,000	—	12,544	106.3	—	946	10,232	431.4	129.3	—	335	11,859	698.2
EC Gdynia I	35,810	—	7,481	—	—	1,802	9,779	—	—	—	1,280	10,728	—
Plant of phosphate fertilizers	513,000	803	3,030	7,631.6	785	23,029	2,372	9,338.2	27.0	730	24,612	2,362	10,406.7
Refinery	3,363,442	1,869	18,562	—	1,700	3,466	16,428	—	—	1,863	4,240	15,250	5.4
Shipur Shipping Agency	50,000	451	1,705	—	428	631	1,766	32.7	0.5	432	386	1,735	6.0
Gdańsk Shipyard	1,356,529	13,697	860	0.5	12,056	3,500	788	0.4	0.6	11,383	3,500	883	0.6
Fat industry plants — of which	77,155	806	—	—	743	2,341	—	—	—	733	—	660	—
Gdynia	34,945	372	—	—	—	1,272	—	—	—	—	—	—	—
Gdańsk	42,210	434	—	—	—	1,069	—	—	—	—	1,190	—	—
Cement plant in Wejherowo	58,322	322	1,430	—	207	—	—	1,413	1.0	256	—	1,906	10.4
Sugar factory in Prusze Gdańskie	—	—	792	44.2	—	828	591	40.0	2.1	—	859	629	11.0
Gas engineering plant in Gdańsk	441,290	1,411	753	—	1,531	—	636	—	—	1,893	—	1,069	—
"Komuny Paryskiej" Shipyard (Gdynia)	921,000	9,227	691	—	8,508	—	582	—	—	8,374	—	354	—
NAUTA Shipyard (Gdynia)	100,000	2,544	380	—	2,296	533	397	—	—	2,318	461	809	—
Repair Shipyard in Gdańsk	587,769	5,578	177	—	5,727	—	430	—	—	5,813	—	393	—
Altogether	9,496,119	38,595	74,088	8,515.7	36,156	69,143	89,260	11,183.3	190.9	35,757	87,487	97,214	12,930.0
The Gdańsk voivodship total	—	146,730	88,558	8,575.2	144,904	89,699	93,776	11,228.1	203.0	—	108,073	115,957	13,036.8

Table 4
Characteristics of municipal sewage treatment plants in the Gdańsk agglomeration, 1986

	Type of plant		Amount of treated sewage	Load factor of plant	Reduction degree of pollution	
	Mechanical	Biological-mechanical			Suspension	BzT ₅
			dam ³ /year	%	%	%
Voivodship total	6	6	79,431	—	—	—
Towns of the agglomeration — of which	3	3	46,569	—	—	—
Gdańsk	1	—	24,373	155.1	52.1	23.9
	—	1	3,040	104.1	67.0	30.6
	—	1	18,518	134.9	62.7	58.9
Gdynia	—	1	37	194.7	26.1	19.4
Pruszcz Gdański	1	—	601	151.8	36.1	14.9
Dębogórze (Kosakowo)	1	—	25,211	88.0	53.4	31.4

There are also big solid waste storage yards in this area of the Gdańsk agglomeration. The biggest, which occupies a 34.1 ha surface, can be found in Wiślinka—close to Pruszcz Gdański, about 8 km to the East of Gdańsk. It has been settled on the phosphogypsum coming from the Phosphatic Fertilizers Plant and having a high rate of toxicity. Within two years the height of this storage yard will have reached 41 m.

On the terrain of the agglomeration there are three big storage yards for the flue dust and slag produced by the heat and power generating plants. Their surfaces are 31, 50 and 120 ha, respectively. Furthermore, there are four municipal waste dumps in the agglomeration serving the functions of industrial storage yards. Their territories are 54, 16, 2 and about 1 ha.

The amount of air pollution is above standard in the 160 km² area of the agglomeration, especially in Gdańsk and Gdynia where 800,000 inhabitants live. It is caused mainly by gases like ammonia, fluorine, benzene, chlorine, hydrogen cyanide, allergic substances, fluorine, sulphuric acid, asbestos dust etc.

Environmental devastation is, above all, due to inappropriate production technologies and the bad organization and management of industry.

The author is going to perform research on the organization of industry in this region, highlighting industry-environment interaction, using the method of graphs and the model of interaction.

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