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# TRIP REPORT TO NITROGEN WORKS, KEDZIERZYN, POLAND

APRIL 26 - MAY 7, 1992

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## TABLE OF CONTENTS


| | | Page |
|---|---|---|
| I. | INTRODUCTION | 1 |
| II. | EXECUTIVE SUMMARY | 2 |
| III. | FINDINGS | 3-8 |
| IV. | CONCLUSIONS AND RECOMMENDATIONS | 9-10 |
| V. | APPENDICES | 11 |

A. List of Persons Consulted

B. General Information on Kedzierzyn Nitrogen Works

C. Environmental Information on Kedzierzyn Nitrogen Works

# I. INTRODUCTION

WEC was requested by "Kedzierzyn Nitrogen Works (KNW) to conduct an environmental review of the facility. Accordingly, WEC assigned a team of two experts, Mr. Roy Detweiler and Dr. Raymond L. Feder, to perform an environmental review, focusing on issues including air and water pollution, hazardous waste generation and disposal, energy usage, waste minimization and health and safety practices.

The team arrived in Kedzierzyn on April 26, 1992 and conducted seven review sessions through May 7, 1992. The team met with Mr. Zbigniew Slezak, Chief Engineer of Development and Mrs. Anna Golab, Division Chief of Environmental Protection, on all occasions and with plant representatives from the various operating areas. Visits were made to all the major operating units with opportunity to discuss the processes in the field with supervisors and managers. A list of persons consulted is in Appendix A.

## II. EXECUTIVE SUMMARY

From April 26 to May 7, 1992, an environmental review of the chemical manufacturing facility at the Kedzierzyn Nitrogen works (KNW), Kedzierzyn-Kozle, Poland was conducted by a team of two experts, Mr. Roy F. Detweiler and Dr. Raymond L. Feder.

The purpose of the review was to assess the status of the facility in relation to environmental measures implemented or which could be implemented. The review included tours of the manufacturing and pollution abatement facilities and meetings and discussions with plant management and operating personnel.

A summary of the history and background and description of major production facilities was prepared by KNW and is attached as Appendix B.

General and specific environmental protection information prepared by KNW is attached as Appendix C.

It was determined that KNW has identified a number of major pollution sources and developed and implemented abatement programs. These measures include the shutdown of obsolete production facilities and the upgrading and/or installation of pollution control equipment and the construction of new production facilities.

Long range modernization plans have been developed to respond to regulatory controls which impose fees and penalties based on the amount of pollutants discharged.

The KNW has an experienced work force possessing a high level of technical competence. Management is aware of the importance of solving environmental problems and has developed long term plans to address environmental problems. Opportunities for short-term improvements are primarily related to energy reduction through the appointment of an energy savings coordinator for day-to-day review of energy usage and maintenance and worker safety and health activities.

## III. FINDINGS

### Overview

The Kedzierzyn Nitrogen Works (KNW) is the second largest chemical plant in Poland. The range of products comprises more than one hundred items including fertilizer and other nitrogen products, oxo-alcohols and other various organic products. The present manufacturing facilities were constructed beginning in 1948 and were expanded several times since and, currently occupy about 800 hectares.

The size and integrated nature of the facility did not allow for a rigorous review. Based on the quantitative and qualitative data obtained from discussions with KNW personnel and observations during plant tours the findings are general in nature, with specific recommendations, where appropriate.

KNW possesses a number of strengths including the following:

- Awareness of importance of solving environmental problem; actively seeking advice; willingness to listen and learn
- Good long-range planning for solving major environmental problems
- Competent technologists and managers
- Experienced work force
- Excellent community relations; employees are neighbors
- Some operating units are world-class
- Space available for modernization and expansion

Management has established priorities to reduce pollutant discharge fees and penalties paid to regulatory agencies based on the amount of current wastewater and solid waste discharged.

The KNW estimates that its pollution control fees for 1991 amounted to approximately 60 billion zlotys or $4.4 million. Appendix C is a listing prepared by KNW of pollution fees charged in 1991 to the various cost centers. Charges against major emission sources by category include:

- $ 760,000 - air emissions
- $2,560,000 - wastewater discharge
- $ 170,000 - solid waste

KNW indicates this could increase to $21 million/year if mitigation measures are not implemented.

KNW reported that regulatory emphasis is being placed on air emissions since these charges can increase several times if suitable plans for reduction are not implemented. Aproximately 80% of the fees for air emissions are assessed to power generation and nitric acid production. For water discharges, approximately 74% of the fees are assessed to the phthalic anhydride, plasticizer and alcohols processes.

KNW has developed long range plans to reduce pollutant discharge fees and penalties as follows:

- Upgrade wastewater treatment facilities by adding a denitrification station
- Modernize the thermal-electric power station
- Modernize the ammonia synthesis plant
- Erect a new nitric acid plant
- Erect a new phthalic anhydride plant

Areas which warrant additional management attention include plant and process maintenance, worker safety and health programs and supervisory and training initiatives. Based on plant tours, the overall appearance of the buildings, grounds and equipment do not compare favorably with Western standards and practices.

A review of safety performance statistics over the last three years (1989-91) indicate injury rates of 7.9, 8.5 and 8.8 per 1000 employees respectively. While specific data regarding employee exposure to hazardous substance was not available, a possibility of exceeding limits for such substances as benzene, formaldehyde, ammonia, carbon monoxide and anhydrides exists.

Housekeeping and maintenance measures require more attention and emphasis to correct and avoid unsafe conditions, i.e. tripping and slipping hazards, broken glass, abandoned equipment and unsafe practices, i.e. welding and electrical cables across walkways and stairs and infrequent use of personal safety and health protection equipment.

Supervisory emphasis and worker training would make significant improvements toward correction of these items.

Plant management at all levels should spend more time in all

plant areas observing work practices and conditions. This applies to safety and housekeeping as well as environmental conditions. Management needs to train employees emphasizing orderliness and attention to detail.

Inspections with follow-up systems are needed. Discussions with top management should be initiated and a strong environmental and safety program initiated.

Air Emissions

The control of air emissions has been identified by KNW as a priority in view of the amount of pollutant discharge fees and penalties currently paid and future increases if control measures are not undertaken. The major air pollution sources are the power plant and the nitric and maleic anhydride plants.

Local authorities require measurements of air emissions twice per year at specified points throughout the entire plant (approximately 40 stacks). At other emission sources in the plant only calculated values are obtained. It is expected that emissions levels for certain contaminants will be specified in 1992. The regulatory authorities supervise the taking of samples by KNW personnel.

Information regarding specific point sources is described below.

Power Plant

Modernization of the power plant will reduce $SO_2$ and particulate emissions. A 90% reduction is required to avoid future regulatory assessments expected to be ten times greater than current assessments. Electrostatic precipitators with efficiencies in the 98-99% range were installed beginning in 1991. Locally available lower sulfur content coal is being sought for purchase to reduce the sulfur content from 0.8% to 0.6%. Coal prices average about 280 zlotys/kg or about $19/ton.

Nitric Acid Plant

The nitric acid plant is one of the most serious pollution sources with annual emissions of about 3000 metric tons as $NO_x$. $NO_x$ emissions are detected up to 20 kms.from the plant. $NO_x$ emissions have abated in the last 2 years due to low production rates.

This plant technology is unique since it uses atmospheric absorption of $NO_x$ into sodium carbonate solution as compared

to higher absorption pressures in other facilities. The low pressure conditions limits the absorption of $NO_x$ resulting in excessive $NO_x$ emissions. In Poland, two other nitric acid producers using moderate pressure absorption can meet regulatory standards for $NO_x$ emissions.

Reduction in $NO_x$ emission concentrations from 1500-2500 ppm to 1000 ppm is expected following the installation of special packing in the absorption towers. This is a first step reduction costing about $100,000 which will reduce regulatory fees by about $200,000/yr. Further emission reduction to 130 ppm $NO_x$ in the tail gas is believed to require selective catalytic reduction (SCR) with ammonia which will cost about $5-7 million.

KNW has committed to meet $NO_x$ standards in 1994 or shut down this plant. Other possible control options include chilling. The SCR approach requires preheating the tailgas to $500^0$F. At this temperature catalytic reduction with a carbon monoxide waste gas could possibly provide an economically viable alternative to SCR.

At KNW, the installation of additional packing to improve the absorption of $NO_x$ in alkaline solution is limited by the pressure of the tail gas exiting the 9 tower acid absorption system. Engineering studies should be initiated to explore methods to introduce additional packing material to increase the absorption of $NO_x$.

Phthalic Anhydride, Maleic Anhydride and Esters Manufacturing Facilities

The anhydride plants do not meet standards for air emissions of phthalic anhydride (PAA), carbon monoxide (CO) and benzene from the maleic anhydride (MAA) plant. The standard for PAA is 0.1 $mg/m^3$, while the calculated average emission is 0.2 $mg/m^3$. Emissions from the MAA plant are benzene (2.3 kg/hr or 16.6 tons/yr) and CO (293 kg/hr or 890 tons/yr). Emissions from the #1 PAA plant are PAA (16 kg/hr or 94 tons/yr) and CO (85 kg/hr or 760 tons/yr). Emissions from the #2 PAA plant are PAA (23 kg/hr or 154 tons/yr) and CO (300 kg/hr or 1500 tons/yr).

The purification train handling the combined crude PAA from the two oxidation systems produces 2,500 tons/yr of solid waste which is transported to the power station for incineration with coal. KNW plans to meet air emission standards are based on installation of a new incinerator to reduce PAA, CO and benzene emissions. This would be part of an overall modernization plan to shut down the naphthalene - based PAA unit and to install more efficient switch

condensers.

New fees to be imposed on benzene emissions will be approximately $74/kg if no corrective action is taken. Present fees are about 5% of proposed fee.

The main contributor to the benzene emissions is the maleic anhydride plant. Present discharge is 2kg/hr of benzene, down from 12 kg/hr in 1990 as a result of better control of benzene oxidation to maleic anhydride. The use of charcoal adsorption to reduce benzene emissions was not previously considered since an economic or ecological justification did not exist. KNW is however presently considering the installation of an incinerator to handle the off-gases from the maleic anhydride unit.

The esters plant which produces phthalates for use as plasticizers has minimum air pollution problems.

Urea Plant

The urea plant, based on Japanese technology of 1950's, has the highest urea manufacturing costs in Poland. It has significant pollution control problems and requires modernization. Discharges from the urea complex are about 1500 tons/yr of ammonia to air.

Oxo Alcohols Plant

This is a modern plant built in 1986. All liquid and gaseous wastes are incinerated in a special incinerator to produce steam for turbines. Total emissions are 40 tons/yr compared to a total of 20,000 tons/yr from all of KNW. Emissions are calculated from material balance numbers.

Wastewater Discharges and Treatment

Wastewater flow for the entire plant is about 1000 $\pm$ 200 $M^3$/hr. Biological treatment started about 2 years ago. There are problems with $NH4^+$ and $NO_2^-$ions which come from the urea plant, from the saltpeter plant and from partial oxidation of $NH_3$ in the nitric acid plants. Total concentration of $NH_3$ is 300-400 g/l which is too high for bacterial treatment. The wastewater treatment plant reduces chemical oxygen demand (COD) from 1500 mg/l to 400 mg/l. Continuing problems exist with the treatment of ammonia compounds.

For the 2nd half of 1992, KNW will have to meet an $NH_3$ standard of 3 mg/l in effluent versus the present concentration of 130 mg/l. Attempts to reduce ammonia concentration by adjusting the ammonia oxidation step were not

successful. However, the COD loading to the wastewater treatment facility from the esters plant is significant. A possible solution to this problem is under investigation through the use of a titanium catalyst to replace the existing sulfuric acid catalyst thus significantly reducing the generation of large quantities of COD wastewaters. Another plant test is scheduled for September, 1992.

## IV. CONCLUSIONS AND RECOMMENDATIONS

The KNW has taken a number of positive steps to identify environmental problems and to develop and carry out strategies to correct them. A number of environmental controls are in place or underway including the wastewater treatment plant; the installation of electrostatic precipitators; process modernization initiatives as well as the shutdown of outdated processes. Long term strategies to reduce emissions from major pollutant discharges sources have been developed considering the regulatory implications to KNW economic viability. The presence of the Department of Environmental Protection within the organization allows KNW to act on both short and long term initiatives in a timely manner. This is particularly important considering the current evolution of Polish environmental laws and regulations. The importance of good community relations and the availability of good technical information to document environmental control measures taken and their effect on the environment is clearly recognized. Community outreach and ambient monitoring efforts are consistent with similar western practices although at a less advanced state.

Areas which merit additional management attention include the development of a definitive corporate environmental policy statement and necessary initiatives to carry it out including increased training and management oversight activities.

A summary of the short term and long term recommendations to advance the environmental improvements taken or under development are listed below.

A. Short-Term

1. Top management should formulate and distribute a policy statement recognizing the commitment of the company to meet or exceed all existing environmental regulations and to anticipate requirements of future regulations with timely compliance steps to avoid future penalties.

2. Establish a central management committee for oversight of a environmental, safety and health program which should be encouraged in each of the production areas. Line management needs to be actively involved in these programs and see to it that the workers are participating.

3. Establish a personal protective equipment policy requiring compliance by workers in all plant areas as part of an overall upgraded safety program.

4. Designate an Energy Savings Coordinator and task force to identify, implement and monitor energy reduction projects to reduce $SO_2$, $NO_x$ and particulate emissions and related emission discharge fees and penalties.

5. Install improved oxygen monitoring equipment and control powerhouse boilers use of excess air.

6. Verify calculated environmental loadings by actual sampling and analysis of appropriate waste streams based on an expanded 7 day, 24 hour sampling program.

7. Examine alternate process flow configurations for absorption of $NO_x$ to determine if cheaper solutions other than selective catalytic reduction are available to reduce $NO_x$ emissions from nitric acid plant.

8. Conduct an economic evaluation of installing an incinerator for phthalic anhydride off-gases independently of overall plant modernization program in view of regulatory emission discharge fees and penalties.

Long-Term

1. Maintain a central management committee oversight of an environmental, safety and health program in each production area. Line management needs to be actively involved in these programs and see to it that the workers are participating.

2. Establish higher standards for housekeeping and appearance.

3. Modernize the power plant.

4. Consider phasing-out production of solid urea production facilities and optimizing urea-water solution production facilities for in-plant uses.

5. Consider modernizing nitric acid production facilities into a single production unit.

6. Expand waste treatment plant to meet all regulations. Expand the waste treatment air blower and aerator agitators to improve oxidation in the existing basins.

7. Consider general purpose incineration for plant liquid and solid wastes.

# V. APPENDICES

## APPENDIX A

### List of KNW Persons Consulted by WEC Experts

| | | |
|---|---|---|
| Mr. Zbigniew Slezak | - | Chief Engineer of Development |
| Mrs. Anna Golab | - | Environment Protection, Division Chief |
| Mr. Janusz Semeniuk | - | Automation Manager, Emission Basic Automatic Control System Operator |
| Ms. Gabriela Jarzebowska | - | Water & Sewage Economy Expert |
| Mr. Arnold Scheit | - | Energetics Div; Vice Chief |
| Mr. Josef Jandrezj | - | Fertilizers Div; Chief |
| Mr. Ratajek Wtodcimier | - | Phthalic Anhydride Plant, Chief |
| Mr. Witold Rusak | - | Development Eng; Fertilizers Expert |
| Mr. Ireneusz Suchanski | - | Nitric Acid Process Engineer |
| Mr. Wojciech Kura | - | Salmag & Nitro-chalk Plant Chief |
| Mr. Tomasz Zomerfeld | - | Organic Division Chief |
| Mr. Novak | - | Ammonia Plant, Engineer |
| Ms. Anna Czernik | - | Plasticizer Process Engineer |
| Mr. Marek Lewicki | - | Oxo Alcohols Technology, Chief Engineer |
| Mr. Zdriskaria Reterska | - | Ammonia Technology, Chief Engineer |
| Mr. Mieczyslaw Tomanek | - | Chief of Safety & Hygiene of Work |
| Mr. Kazimer Rozycki | - | Chief of Chemical Life-Saving |
| Mr. Andrez Hynek | - | Trybuna of ZA "Kedzierzyn" Editor-in-Chief |
| Mr. Grzegorz Gawor | - | Development Director |

ZAKŁADY AZOTOWE "KĘDZIERZYN"

# G E N E R A L  I N F O R M A T I O N


| | |
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1991

# I BACKGROUND

## 1. History-making events

The "KĘDZIERZYN" Nitrogen Works were erected on the ruins of a German factory owned by IG Farben Industrie.

Our Government made a decision in 1948 to build the Works. The significant production activity was started in 1954, i.e. when the first plant of the fertilizer line was put into operation. The line was called "Azot I" (Nitrogen I) and was to produce ammonia - nitric acid - nitro-chalk.

The first plants to manufacture organic products - phthalic anhydride, waxes, amino plastics and fatty acids - were put into operation in 1955.

The next nitrogen line, the so called Azot II, was commissioned in 1957. The plants were started up then to produce urea, concentrated nitric acid and mixed nitric and sulphuric acids.

In the 60´s, our own thermal-electric power station began its operation as well as new production plants were commissioned to produce: sodium nitrite and sodium nitrate, formalin, urea-formaldehyde adhesives, phthalic esters, phthalic anhydride II, cyanogen-diamide and melamine, urea II. The obsolete fatty acids plant was shut down.

In the 70´s, our plants to produce nitric acid were subject to modernization. Further production plants were commissioned, too: fatty alcohols and amines, argon, phthalic anhydride III, maleic anhydride, formalin II and formalin III.

In 1978 our new syn-gas plant was put into operation to supply syn-gas for our ammonia plant. Natural gas replaced coke as our feedstock.

In the 80´s, our most exploited and noxious plants were shut down: phthalic anhydride I, nitro-chalk I and urea I.

14

Surface-active agents were introduced into our range of products.

In 1986, our new syn-gas plant, pure hydrogen plant as well as oxo-alcohols plant (butanols and 2-ethylhexanol) were commissioned. So was our new plant of urea adhesives.

The production of magnesium containing nitro-chalk began in 1987. A new plant for mechanical granulation of this product called "Salmag" was built.

In 1990, our most noxious and dangerous plant of concentrated nitric acid as well as mixed nitric and sulphuric acids was stopped. So was the coke oven gas fractionation unit.

We also commissioned our new central mechanical-biological sewage-treatment plant and we brought to an end the assembly of electrostatic precipitators in our thermal-electric power station.

We started the production of our first household product - a dishwasher.

## 2. Today

The "KĘDZIERZYN" Nitrogen Works are the second big chemical factory in Poland.
The real estate of our Works comprises more than 50 various production plants and auxiliary units taking up some 800 ha of land.

We have got some 5.300 employees now.

Our range of products comprises more than 100 items, and our production capacity is about 4.000 Mg/day.

Our sales in 1990 amounted to 1.753 mld zł (i.e. $ 185 million). The exports gave some 43 % of that. Our net profit amounted to 212 mld zł (i e. $ 22 million).

The fertilizer production which was dominating in the past, together with other nitrogen compounds, gives us some 1/3 of our income. Our oxo-alcohols plant which was commissioned not long ago, gives also some 1/3 of our income. The remaining 1/3 is earned by a few tens of various organic products.

The production activity of the "KĘDZIERZYN" Nitrogen Works can be divided into following areas:

- technical grade gases and ammonia
- nitric acid as well as saltpetres and salmag
- formalin, urea as well as resins and adhesives
- oxo-alcohols
- phthalic and maleic anhydrides and esters
- fatty alcohols and amines and other oleochemicals.

We are a sole Polish supplier of the following products: argon, sodium nitrite, salmag, fatty alcohols and amines, waxes and synthetic adhesives, phthalic and maleic anhydrides, iso-butanol, 2-ethylhexanol, fumaric acid as well as many more small lot products.

Our development program puts much pressure on ecological effects of our production. The spectrum of the offered products is to be widened, too.
In 1991, the changes will start to make our economy more private controlled.

## 3. Energy demand, fuels utilized

We have got our own thermal-electric power station which provides the Works with electricity and steam necessary for production processes.
Our power station utilized in 1990:

| | |
|---|---|
| coal | 93,7 % |
| tail gases | 5,0 % |
| oils and wastes | 1,3 % |

Annual consumption of our main fuel - coal - was:

- 582.000 Mg in 1989 ; 504.000 Mg in 1990.

Our thermal-electric power station delivers steam 7,0 MPa, 1,5 MPa and 0,6 MPa, total heat is about 9-10 million GJ/year. This covers about 74 % of our demand. The remaining 26 % was in 1990 completely covered by heat recovery processes.

Our demand for electricity amounted to
1.177 GWh in 1989 and 944 GWh in 1990.
Our own production could cover some 34 % of the demand. Another about 66 % had to be bought from outside. Those figures are for 1990.
The thermal-electric power station is obsolete. Its production facilities have been operating for over 30 years now.
The pulverized-coal boilers have been provided with electrical precipitators. New fluidized-bed boilers are planned to be introduced.

## 4. Sources of supplies of water and other feedstocks

### Water

Water consumption both for process needs and for energy production was as follows (in thousand $m^3$/year):

| | 1989 | 1990 |
|---|---|---|
| water from the Odra river | 24.212,8 | 19.398,5 |
| water from a stream | 4.479,2 | 4.717,7 |
| water from Tertiary layers | 2.800,9 | 2.953,7 |
| water from Quaternary layers | 3.825,3 | 2.825,5 |
| water from sand mine | 2.421,7 | 1.570,1 |
| Total | 37.739,9 | 31.465,5 |

Sources of other raw materials:

Natural gas (for production of syn-gas)

Supplier: All-Poland network for natural gas supplies
1989 - 384.640 thousand $m^3$

17

1990 - 326.760 thousand $m^3$

Coke-oven gas (for heating needs)

Supplier: "ZDZIESZOWICE" Coking Plant
1989 - 121.716 thousand $m^3$
1990 - 43.583 thousand $m^3$

Methanol (for formalin production)

Supplier: "CHORZÓW" Nitrogen Works
1989 - 60.350 Mg
1990 - 40.254 Mg

Propylene (for oxo-alcohols production)

Supplier: Mazovian Refinery and Petrochemical Works at Płock as well as imports from former GDR and from Hungary
1989 - 81.944 Mg
1990 - 78.792 Mg

Fatty acids (to produce fatty alcohols)

Supplier: "POLLENA" at Nowy Dwór Mazowiecki
"STREM" at Strzemieszyce
1989 - 9.680 Mg
1990 - 5.109 Mg

Orthoxylene (to produce phthalic anhydride)

Supplier: Mazovian Refinery and Petrochemical Works at Płock
1989 - 20.346 Mg
1990 - 15.000 Mg

Benzene (to produce maleic anhydride)

Supplier: Mazovian Refinery and Petrochemical Works at Płock
1989 - 6.796 Mg
1990 - 5.480 Mg

## II INFORMATION ABOUT PRODUCTS / PROCESSES

### 1. Ammonia

#### Syn-gas production from natural gas

The process of "KĘDZIERZYN" Nitrogen Works and H. Topsoe of 1978. The process is modern, condition of the plant - good, in operation - 13 years.

#### Synthesis of ammonia

The process of "PROSYNCHEM" at Gliwice and "KĘDZIERZYN" Nitrogen Works, dates back to the 50´s - 60´s. In operation for over 30 years, the plant is decapitalized.
Production capacity: 437.000 Mg/year
Annual production: 1989 - 406.500 Mg 1990 - 295.008 Mg
The process consists in semi-combustion of natural gas in air and oxygen with the use of a nickel catalyst. Then CO is subject to high-temperature and low-temperature conversion. $CO_2$ is washed out with water and potassium carbonate. The remaining CO is washed out with copper lye and then ammonia is synthesized from $N_2$ and $H_2$ under pressure of 30 MPa.
A new synthesis unit is just under construction to replace the old one and the $CO_2$ wash-out unit is retrofitted.

### 2. Nitric Acid

The process of "PROSYNCHEM" at Gliwice and GIAP in Moscow dates back to the 50´s. In operation for nearly 40 years.
The plant requires thorough modernization since it is exploited out and noxious for environment.
Production capacity: 480.000 Mg/year
Annual production: 1989 - 460.820 Mg 1990 - 350.760 Mg
The process to produce nitric acid comprises atmospheric oxidation of ammonia with air and with the use of a Pt-Rh catalyst. Nitric oxides are then absorbed in water under atmospheric pressure, while tail oxides are absorbed in a soda solution.

## 3. Ammonium Nitrate

The process of GIAP in Moscow dates back to 1957. The plant is in operation for 35 years and requires thorough modernization.
Production capacity: 220.000 Mg/year
Annual production: 1989 - 177.260 Mg 1990 - 122.390 Mg
The process consists in continuous raising the concentration of the nitrate solution till it reaches min. 99,7 %. A 3-step evaporating system is employed followed by tower granulation of the obtained melt.

## 4. Nitro-chalk

The process was modernized by "KĘDZIERZYN" Nitrogen Works in 1972. Production facilities dating back to mid-50's have been in operation for over 30 years now. The plant is to be shut down when the "Salmag" production is intensified.
Production capacity: 205.000 Mg/year
Annual production: 1989 - 220.270 Mg 1990 - 93.100 Mg
The process consists in continuous raising the concentration of the nitrate solution and in mixing the melt with the dolomite powder. Then tower granulation follows.

## 5. Salmag

The process to prepare the nitrate melt was delivered by "KĘDZIERZYN" Nitrogen Works, granulation - by Babcock , 1987. The plant is modern and has been in operation for 5 years now.
Production capacity: 330.000 Mg/year
Annual production: 1989 - 244.750 Mg 1990 - 255.540 Mg
The process comprises neutralization of ammonia with nitric acid and thickening the solution to reach the concentration of 75 %.
Certain part of such a solution is fed into the plants to produce ammonium nitrate and nitro-chalk. The remaining amount is concentrated to reach 95 % and then subject to mechanical granulation together with the admixture of dolomite powder.

## 6. Urea

The process of Toyo-Koatsu of 1962. The plant has been in operation for 26 years now. Its technical condition is satisfactory, yet some modernization is required because of environmental effects.
Production capacity: 181.440 Mg/year
Annual production: 1989 - 187.060 Mg 1990 - 150.253 Mg
Ammonia and carbon dioxide react under pressure of 25 MPa to give urea. The obtained solution is thickened then, the product subject to crystallization, drying and tower granulation.

## 7. Formalin

The process of "KĘDZIERZYN" Nitrogen Works of 1975. The plant operation time - 15 years. Its technical condition - good. Though, its cooling systems require modernization.
Production capacity: 55.000 Mg/year
Annual production: 1989 - 49.092 Mg 1990 - 34.740 Mg
The process consists in dehydrogenating oxidation of the methanol-water mixture, with the use of a silver catalyst. Gaseous formaldehyde is absorbed in water then.

## 8. Urea-formaldehyde adhesives

The process of "KĘDZIERZYN" Nitrogen Works of 1985.
In operation - 5 years.
Production capacity: 146.000 Mg/year
Annual production: 1989 - 120.530 Mg 1990 - 73.000 Mg
Urea is continuously condensed under pressure with formaldehyde. The product is then subject to vacuum thickening, further condensation, homogenization and cooling.

## 9. Oxo-alcohols

The process of Union Carbide of 1981. In operation - 5 years. The plant is modern, its technical condition being very good.
Production capacity: 133.450 Mg/year
Annual production: 1989 - 111.130 Mg 1990 - 118.816 Mg
The process consists in low-pressure hydro-formylation of propylene

with the use of a homogeneous rhodium catalytic complex. The obtained aldehydes are subsequently subject to further condensation (aldolization) and hydrogenation to give 2-ethylhexanol. Butyraldehydes are subject to hydrogenation, too, to give butanols.

## 10. Phthalic Anhydride

The process of "KĘDZIERZYN" Nitrogen Works of 1960.
Two production lines are completely decapitalized. One of them has been in operation for over 30 years, the other for some 20 years. Totally modernization is required due to their environmental noxiousness and wear-out.
Production capacity: 46.000 Mg/year
Annual production: 1989 - 41.880 Mg 1990 - 28.500 Mg
The process comprises oxidation of naphthalene and orthoxylene with air in the presence of a vanadium catalyst followed by product separation and purification.

## 11. Maleic Anhydride

The process of "KĘDZIERZYN" Nitrogen Works of 1970.
The plant has been in operation for 17 years now and needs modernization due to its harmfull effects on environment.
Production capacity: 6.000 Mg/year
Annual production: 1989 - 5.555 Mg 1990 - 3.600 Mg
The process comprises oxidation of benzene with air on a vanadium-molybdenum catalyst followed by product separation and purification.

## 12. Phthalate softening agents

The process of "KĘDZIERZYN" Nitrogen Works of 1987.
The domestic production facilities date back to the 70's and 80's. After making the process continuous, the plant has been in operation for 4 years, and it is in the course of modernization.
Production capacity: 70.700 Mg/year.

Annual production: 1989 - 58.070 Mg 1990 - 44.531 Mg
The process comprises continuous estrification of phthalic anhydride with 2-ethylhexanol or butanol. The product is subject to further neutralization, washing, refining and filtering.

## 13. Fatty Alcohols

The process of Lurgi, "KĘDZIERZYN" Nitrogen Works and ICSO "BLACHOWNIA", of 1970.
The plant has been operating for 20 years now, yet its condition is satisfactory.
Production capacity: 6.550 Mg/year
Annual production: 1989 - 5.840 Mg 1990 - 3.430 Mg
The process consists in direct high-pressure hydrogenation of natural fatty acids. Suspension catalysts are employed to obtain saturated or unsaturated alcohols, respectively.

## 14. Fatty Amines

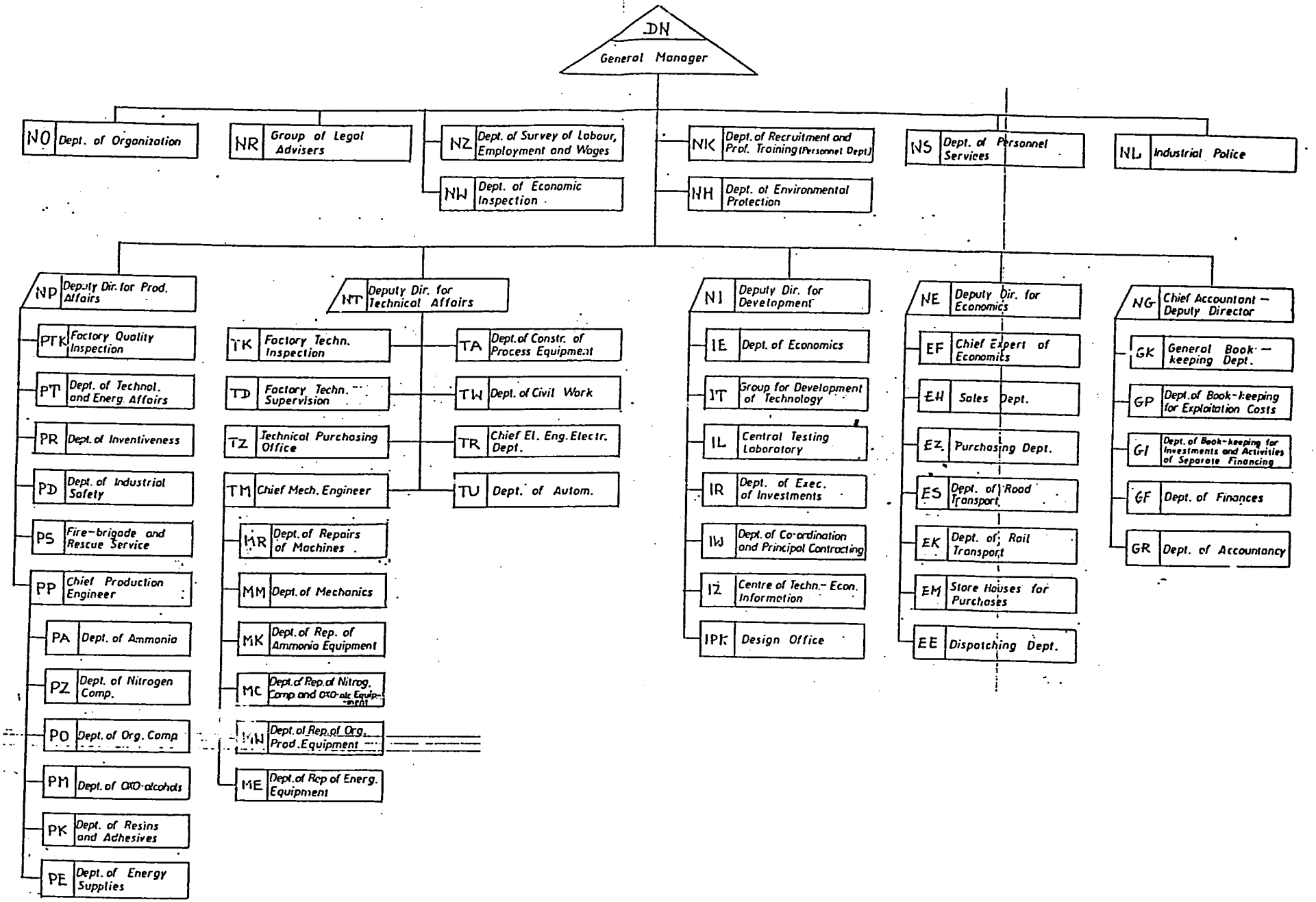
The process of ICSO "BLACHOWNIA" and "KĘDZIERZYN" Nitrogen Works, of 1978. The plant has been operating for 12 years now and its condition is pretty good.
Production capacity: 1.600 Mg/year
Annual production: 1989 - 756 Mg 1990 - 749 Mg
The process comprises continuous ammonolysis of fatty acids to give nitriles. Then nitriles are batchwise hydrogenated to give fatty amines. Suspension nickel catalyst is employed to achieve the last-mentioned.

## 15. Stearin

The process of "KĘDZIERZYN" Nitrogen Works, IChP in Warsaw and ICSO "BLACHOWNIA" , of 1983.
The plant has been operating for 12 years now and its technical condition is good.
Production capacity: 6.000 Mg/year
Annual production: 1989 - 2.350 Mg 1990 - 607 Mg
The process consists in hydrogenation of fatty acids with a suspension nickel catalyst employed.

B/...

# III ORGANIZATIONAL STRUCTURE



## Management

The managing agencies of our Works are as follows:

1. General Conference of Delegates
2. Council elected by employees
3. General Manager

The comparison of the economic dates for 1986-1990

/in thousands of zł./

| Nb. | SPECYFICATION | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| 1. | Sale | 34,369,185 | 51,877,980 | 95,009,196 | 269,334,404 | 1,753,560 |
| 2. | Cost | 32,293,626 | 48,488,578 | 83,453,388 | 206,062,740 | 1,408,705 |
| 3. | Profit before taxes | 2,313,813 | 5,791,866 | 15,788,180 | 96,457,660 | 423,962 |
| 4. | Taxes and others charges | 1,216,954 | 3,060,798 | 6,385,381 | 32,271,157 | 212,166 |
| | - income tax | 1,216,954 | 3,029,772 | 5,690,390 | 26,216,910 | 0 |
| | - stabilization tax | 0 | 0 | 138,128 | 0 | 0 |
| | - remuneration increase tax | 0 | 31,026 | 556,863 | 0 | 0 |
| | - dividend | 0 | 0 | 0 | 6,054,247 | 0 |
| 5. | Net profit | 1,096,859 | 2,731,068 | 9,402,799 | 64,186,503 | 211,796 |
| 6. | Part in profit others units | 98 | 99 | 3,862 | 2,336,773 | - |
| 7. | Profit for partition | 1,096,957 | 2,731,167 | 9,406,661 | 66,523,276 | - |
| 8. | Partition of the profit at: | | | | | |
| | - reserve found | 113,040 | 198,748 | 607,637 | 0 | - |
| | - introduce found | 3,699 | 11,055 | 67,362 | 0 | - |
| | - found of factory staff | 305,898 | 481,628 | 1,837,716 | 13,785,338 | - |
| | - found of development | 631,320 | 2,019,736 | 6,850,734 | 52,493,483 | - |
| | - others objects | 43,000 | 20,000 | 43,212 | 244,455 | - |

50 0 50 100 km
KALININGRAD
GDAŃSK
SŁUPSK
KOSZALIN
ELBLĄG
OLSZTYN
SZCZECIN
BYDGOSZCZ
TORUŃ
PIŁA
GORZÓW WLKP.
POZNAŃ
WŁOCŁAWEK
PŁOCK
GIECHANÓW
OSTROŁĘKA
ŁOMŻA
BIAŁYSTOK
WARSZAWA
SIEDLCE
ZIELONA GÓRA
LESZNO
KALISZ
SIERADZ
ŁÓDŹ
SKIERNIEWICE
RADOM
PIOTRKÓW TRYB.
LUBLIN
CHEŁM
ZAMOŚĆ
WROCŁAW
LEGNICA
JELENIA GÓRA
WAŁBRZYCH
OPOLE
KIELCE
CZĘSTOCHOWA
TARNOBRZEG
KATOWICE
KRAKÓW
TARNÓW
RZESZÓW
PRZEMYŚL
KROSNO
NOWY SĄCZ
BIELSKO
BIELA
OSTRAVA
HRADEC KRÁLOVÉ
PRAHA
BRIEST
LWÓW
POLSKA – mapa administracyjna

APPENDIX C

The "KĘDZIERZYN" Nitrogen Works
Joint-stock Company
at Kędzierzyn-Koźle

Environmental Protection Dept.

# INFORMATION
## ON ENVIRONMENTAL PROTECTION
## IN 1991

This information refers to these elements of the environment which are influenced by the activities carried out by our Works. Some economical factors have also been presented which are connected with the present obligatory system of fees and fines as well as the execution of the plan for environmental protection in 1991.

### 1. Emissions to atmosphere

In 1991 our Works emitted 22,607.1 Mg of various pollutants, with 2,670.4 Mg being dusts and 19,936.7 Mg being gases (88.2%).

Compared to 1990, the emission was reduced by 6.1 % (i.e. 1,462.6 Mg), with the emission of dusts being lesser by 35.3 % (i.e. by 1,457.9 Mg) and the emission of gases being reduced by 0.02 % (i.e. by 4.7 Mg) (refer to Table No. 1).

The highest amounts of pollutants were emitted by:

- Power Engineering Dept. - 10,798 Mg/y (47.8 %)
- Urea and Urea Adhesives Dept. - 4,155 Mg/y (18.3 %)
- Nitrogen Compounds Dept. - 3,861 Mg/y (17.1 %)
- Organic Products Dept. - 3,702 Mg/y (16.4 %)

Total emission from those Departments amounted to 22,516 Mg, i.e. about 99.6 % of that of the whole Works.

The remaining 0.4 % came from:

- Ammonia Dept. - 46 Mg/y (0.2 %)
- OXO Dept. - 46 Mg/y (0.2 %)



28

The figures and types of emitted pollutants for separate Depts have been gathered in Table No. 2.

Among the emitted pollutants, the following had the highest shares:

| | |
|---|---|
| - Sulphur dioxide | about 6,521 Mg (28.8 %) |
| - Nitrogen oxides (in terms of $NO_2$) | about 5,313 Mg (23.5 %) |
| - Ammonia | about 4,326 Mg (19.1 %) |
| - Carbon monoxide | about 3,531 Mg (15.6 %) |
| - Power plant dusts | about 1,865 Mg ( 8.2 %) |

and they can be added together to give the amount of 21,556 Mg, i.e. about 95.2 % of the total emission. The rest of 4.8 % (1,051 Mg) is composed of the remaining 42 pollutants.

The following emissions were reduced in 1991:

| | |
|---|---|
| - Carbon monoxide | by 1,963 Mg |
| - Nitrogen oxides | by 1,369 Mg |
| - Power plant dusts | by 920 Mg |
| - Ammonium nitrate | by 428 Mg |
| - Phthalic anhydride | by 94 Mg |
| - Dolomite dust | by 73 Mg |
| - Benzene | by 46 Mg |

The main reasons for the reduction of said pollutants were as follows:

- for carbon monoxide, benzene and phthalic anhydride - reduction of production rate,
- for power plant dusts - all operated electro-filters were subject to overhaul,
- for process-derived nitrogen oxides - reduction in production rate,
- for ammonium nitrate - increased efficiency of multi cyclones down the line of coolers at the Nitro-Chalk Plant II and down the line of drum drier at the Nitro-Chalk Plant III,
- for dolomite dust - utilization of Old Milling Plant was limited.

Yet, there was some increase observed in the emission of:

- ammonia by 2,069 Mg
- sulphur dioxide by 1,384 Mg

The reasons for that were:

- for ammonia - modification of sampling and analytical procedures as well as a failure of a cooler down the line of evaporators at the Urea Plant II,
- for sulphur dioxide - modification of measurement procedure.

Those changes in procedures introduced in 1991 allow no direct comparison of the emission levels in the discussed years.

## 2. Water

The balance of water consumed by ZAK in 1990 and 1991 is shown in a table below.

| Pos. | Type of water | 1990 thousand $m^3$ | 1991 thousand $m^3$ |
|---|---|---|---|
| 1. | Water from Odra River | 19,398.5 | 17,004.3 |
| 2. | Water from Łącza stream | 4,717,7 | 3,563.9 |
| 3. | Water from tertiary strata | 2,953.7 | 2,433.4 |
| 4. | Water from quaternary strata | 2,825.5 | 2,035.4 |
| 5. | Water from Kotlarnia sand pit | 1,570.1 | 1,189.5 |
| | Total | 31,465.5 | 26,226.5 |

It can be seen from the above data that, referred to 1990, total consumption of water was reduced by approx. 16.6 %, i.e. by 5,239 thousand $m^3$.

For separate water sources, the said reduction looks as follows:

- water from Odra River by 2,394,2 thousand $m^3$ (12.3 %)
- water from Łącza stream by 1,153.8 thousand $m^3$ (24.5 %)
- water from tertiary strata by 520.3 thousand $m^3$ (17.6 %)

- water from quaternary strata by 790.1 thousand $m^3$ (27.9 %)
- water from Kotlarnia sand pit by 380.6 thousand $m^3$ (24.2 %)

This situation was mainly caused by lower operating rates as well as by eliminating some parts of syn-gas pretreatment line which were much water-consuming.

## 3. Sewage water

The amounts of disposed waste water were reduced in 1991 compared to suitable figures of 1990 by 740 thousand $m^3$, i.e. by some 3.0 %.

In 1991, the load for all the tested parameters was reduced, except for ammonium-derived nitrogen, suspension and chromium.

The substantial parameters were reduced:

- COD by 1,189 Mg (i.e. by some 22 %)
- $BOD_5$ by 2,014 Mg (i.e. by some 53 %)

The increase of disposed amounts of ammonium-derived nitrogen was caused mainly by emergency disposal from the Urea and Nitro-chalk Plants. The increase in suspension load came from higher amounts of power plant dump water and the failure of primary settling tanks at our sewage treatment plant in May 1991. The increased amounts of chromium can be explained for by higher level of waste water from our Chromopol Plant. Detailed specific tion and changes in disposed pollutants have been presented in Table No. 3 thereof.

In terms of individual Depts, the following loads of COD were disposed:

- Organic Products Dept. 2,365.1 Mg (56.8 %)
- OXO Alcohols Dept. 241.9 Mg (5.8 %)
- Urea Adhesives Dept. 149.4 Mg (3.6 %)
- Experimental Prod. Dept. 6.5 Mg (0.16 %)

The remaining 33.64 % come from used cooling water sent to storm -water drain system.

The highest share of the disposed ammonia load came from the Urea Plant II (about 70 %), and then the syn-gas treatment unit, nitro-chalk unit and amines unit followed.
The achieved improvement in the field of organic pollutants was first of all due to the start-up of the biological sector of our Central Mechanical-Biological Sewage Treatment Plant. Production limitations should be also added to this picture.

After the commission of that part of our CMBSTP, the problems of ammonia and cooling water are the two to be solved to get things in order. The first will be managed by further reduction of disposed amounts (shut-down or modernization of Urea Plant II) and biological removal of disposed load. In order to reduce the volume of disposed sewage water and to reduce the load contained therein, it is planned to recycle all used cooling water and its reconditioning.

## 4. Wastes

The amount of environmentally harmful wastes amounted to 211.6 thousand Mg in 1991 (with power plant wastes carrying 30 % of water) and was by 20.6 thousand Mg (10.8 %) higher than in 1990. The amount of power station wastes reached 208.3 thousand Mg what reads the increase of 21.5 thousand Mg (i.e. by 11.5 %). This, however, was the result of increased efficiency of our electro-filters which had been retrofitted.

The process wastes (3.8 thousand Mg) were lowered by 0.5 thousand Mg (i.e. by 11.6 %) what was the result of lower capacity utilization.

From the above mentioned figures for process wastes, some 1.6 thusand Mg was incinerated and another 0.4 thousand Mg could be sold out. The rest just had to be stored on a toxic wastes store yard. The power plant wastes (alike in previous years) were in 100 % stored on dumps.



32

## 5. Economical aspects of environmental protection

### 5.1. Fees

The table below provides the level of fees for utilizing natural resources after changes introduced thereto in 1991.

| Pos. | Specification | Fee (in million zł) |
|---|---|---|
| 1. | consumption of water | 12,400 |
| 2. | disposal of organic compounds in sewage water | 34,500 |
| 3. | emissions to atmosphere | 10,300 |
| 4. | storage of wastes | 2,300 |
| | Total | 59,500 $4MM |

The fees amounted to 2.77 % of the Works' manufacturing costs in 1991.

### 5.2. Fine charges

13,500 zł = $1

The sums paid for the infringement of the environmental protection rules were as follows (in 1991, in million zł):

| | | |
|---|---|---|
| - emissions to atmosphere | about 6,041.0 x) | $.5MM |
| - load disposed in sewage water | about 31.5 | |
| Total | about 6,072.6 | $.5MM |

x) no decision made, fines are not charged since 01.07.1991;

The percentage of fines in the Works' profit has not been calculated since we had negative profit in 1991.

Note:
No changes in fees and fines have been discussed nor compared for 1990 and 1991 since the rates were changed starting from 01.01.1991.



- 27

## 6. Execution of the planned projects for environmental protection in 1991

### I Water protection

Two projects were planned, and one of them was implemented (that was a titanium catalyst - not used right now). Completion of another project called "Cleaning up the sewage settling tank No. 4" was put off till Q4, 1992 as we have no financial means available.

### II Atmospheric air protection

Seven projects were planned in this field and five of them were implemented. The remaining two are just in the process of execution, and their time limits were put off till this year. They are:

a) construction of a station for loading railway tanks with liquid/melted phthalic anhydride;
(some 90 % have already been executed).
- expected completion time - Q3, 1992.

b) overhaul of pipelines for dust removal from packing machines - because of a very broad range of work to be performed, this cannot be an overhaul and will be an investment project; the technical-economical fore design is ready.

### III Management of wastes

All three planned projects have been executed.

### IV Protection against noise

One project was planned and was executed.

Enclosures:
Tables 1 - 4.



34

Environmental Protection Dept.

Table No. 1.

Figures for the pollution
in 1990 and 1991

| Pos. | Pollutant | Emission of pollutants (Mg) | |
|---|---|---|---|
| | | 1990 | 1991 |
| I | DUSTS | | |
| 1. | Fly ash from power plant | | |
| 2. | - suspended dust | 835.468 | 745.905 |
| 3. | - total dust | 1,949.424 | 1,118.858 |
| 4. | Sodium nitrite | 8.746 | 10.599 |
| 5. | Sodium nitrate | 8.362 | 1.091 |
| 6. | Ammonium nitrate | 580.673 | 152.712 |
| 7. | Dust of chromopol | 23.632 | 25.414 |
| 8. | Urea | 200.098 | 262.758 |
| 9. | Dolomite dust | 94.685 | 21.963 |
| 10. | Soda dust | 1.461 | 0.739 |
| 11. | Phthalic anhydride | 343.695 | 250.149 |
| 12. | Maleic anhydride | 68.322 | 69.831 |
| 13. | Naphthoquinone | 0.000 | 0.011 |
| 14. | Naphthalene | 1.429 | 1.234 |
| 15. | Calcium oxide | 0.013 | 0.011 |
| 16. | Resins | 10.149 | 7.054 |
| 17. | Chromium (+3) | 0.273 | 0.248 |
| 18. | Chromium (+6) | 1.768 | 1.776 |
| | Total dusts | 4,128.255 | 2,670.372 |



35

| | | | |
|---|---|---|---|
| II | GASES | | |
| 1. | Sulphur dioxide | 5,136.958 | 6,521.142 |
| 2. | Nitrogen oxides | | |
| | - process-born | 5,983.979 | 3,198.154 |
| | - power-plant-born | 697.695 | 2,114.741 |
| 3. | Carbon monoxide | | |
| | - process-born | 5,241.940 | 3,206.467 |
| | - power-plant-born | 252.317 | 324.854 |
| 4. | Benzene | 63.976 | 17.871 |
| 5. | Ammonia | 2,257.274 | 4,325.585 |
| 6. | Formaldehyde | 5.667 | 3.796 |
| 7. | Methanol | 60.476 | 38.789 |
| 8. | Butanol | 26.983 | 25.953 |
| 9. | o-Xylene | 47.175 | 31.447 |
| 10. | Methane | 47.966 | 36.167 |
| 11. | Olefins | 0.950 | 0.479 |
| 12. | Octanol | 22.573 | 18.193 |
| 13. | Isooctylene | 63.701 | 51.338 |
| 14. | Dibutyl phthalate | 0.050 | 0.052 |
| 15. | Dioctyl phthalate | 0.012 | 0.010 |
| 16. | Acetic acid | 0.152 | 0.179 |
| 17. | Sulphuric acid | 11.256 | 7.556 |
| 18. | Hydrochloric acid | 0.003 | 0.003 |
| 19. | Fatty acids | 4.730 | 4.990 |
| 20. | Ethylene glycol | 4.179 | 4.199 |
| 21. | Phenol | 0.018 | 0.006 |
| 22. | Ethylenediamine | 0.018 | 0.012 |



36

| | | | |
|---|---|---|---|
| 23. | Butyl acetate | 1.732 | 2.093 |
| 24. | Methyl acetate | 0.000 | 0.001 |
| 25. | Butyraldehyde | 0.004 | 0.004 |
| 26. | o-Tolylaldehyde | 4.922 | 0.402 |
| 27. | Aliphatic hydrocarbons | 3.037 | 1.896 |
| 28. | Aromatic hydrocarbons | 0.485 | 0.303 |
| 29. | Benzo(α)pyrene | 0.006 | 0.040 |
| 30. | Hydrogen sulphide | 1.040 | 0.000 |
| 31. | Benzol | 0.022 | 0.000 |
| 32. | Phthalyde | 0.141 | 0.000 |
| | Total gases | 19,941.437 | 19,936.721 |
| | Total emissions | 24,069.692 | 22,607.093 |



31

Environmental Protection Dept.

Table No. 2.

Emissions of pollutants from separate departments, comparison of 1990 and 1991

| Pos | Pollutant | Emission (Mg) | | Changes (Mg) |
|---|---|---|---|---|
| | | 1990 | 1991 | |
| 1. | Ammonia Dept. | | | |
| | Ammonia | 5.051 | 5.015 | -0.036 |
| | Carbon monoxide | 30.919 | 25.530 | -5.389 |
| | Methane | 24.203 | 14.953 | -9.250 |
| | Olefins | 0.950 | 0.479 | -0.471 |
| | Total | 61.123 | 45.977 | -15.146 |
| 2. | Nitrogen Compounds Dept. | | | |
| | Nitrogen oxides | 5,968.129 | 3,185.878 | -2,782.251 |
| | Sodium nitrite | 8.748 | 10.599 | 1.851 |
| | Sodium nitrate | 8.362 | 1.091 | -7.271 |
| | Ammonia | 2,248.656 | 487.823 | -1,761.033 |
| | Ammonium nitrate | 580.678 | 152.712 | -427.966 |
| | Dolomite dust | 94.685 | 21.963 | -72.722 |
| | Soda dust | 1.461 | 0.739 | -0.722 |
| | Total | 8,910.919 | 3,860.805 | -5,050.114 |
| 3. | Power Engineering Dept. | | | |
| | Suspended dust | 835.468 | 745.905 | -89.563 |
| | Total dust | 1,949.424 | 1,118.858 | -830.566 |
| | Sulphur dioxide | 5,096.957 | 6,493.457 | 1,396.500 |
| | Nitrogen oxides | 697,695 | 2,114.741 | 1,417.046 |
| | Carbon monoxide | 252.317 | 324.854 | 72.537 |



78

| | | | | |
|---|---|---|---|---|
| | Benzo(α)pyrene | 0.006 | 0.040 | 0.034 |
| | Total | 8,831.867 | 10,797.855 | -1,965.988 |
| 4. | Organic Products Dept. | | | |
| | Nitrogen oxides | 15.850 | 12.276 | -3.547 |
| | Maleic anhydride | 68.322 | 69.851 | 1.529 |
| | Sulphur dioxide | 40.001 | 27.685 | -12.316 |
| | o-Xylene | 47.175 | 31.447 | -15.729 |
| | Naphthalene | 1.429 | 1.234 | -0.195 |
| | o-Tolylaldehyde | 4.922 | 0.402 | -2.607 |
| | Formaldehyde | 3.800 | 2.315 | -1.485 |
| | Methanol | 19.268 | 3.170 | -16.098 |
| | Butanol | 3.220 | 4.739 | 1.519 |
| | Phthalic anhydride | 343.695 | 250.149 | -93.546 |
| | Benzene | 63.976 | 17.871 | -46.105 |
| | Dibutyl phthalate | 0.050 | 0.052 | 0.002 |
| | Dioctyl phthalate | 0.012 | 0.010 | -0.002 |
| | Octanol | 22.573 | 18.193 | -4.380 |
| | Isooctylene | 63.701 | 51.338 | -12.363 |
| | Acetic acid | 0.152 | 0.179 | 0.027 |
| | Sulphuric acid | 11.256 | 7.556 | -3.700 |
| | Hydrochloric acid | 0.003 | 0.003 | 0.000 |
| | Fatty acids | 4.730 | 4.990 | 0.260 |
| | Ethylene glycol | 4.179 | 4.199 | 0.020 |
| | Calcium oxide | 0.013 | 0.011 | 0.002 |
| | Phenol | 0.018 | 0.006 | -0.012 |
| | Ethylenediamine | 0.018 | 0.012 | -0.006 |
| | Butyl acetate | 1.732 | 2.093 | 0.361 |
| | Resins | 10.149 | 7.054 | -3.095 |



39

| | | | | |
|---|---|---|---|---|
| | Carbon monoxide | 5,207.457 | 3,177.760 | -2,029.697 |
| | Aliphatic hydrocarbons | 3.037 | 1.896 | -1.141 |
| | Aromatic hydrocarbons | 0.485 | 0.303 | -0.182 |
| | Ammonia | 3.367 | 2.713 | -0.654 |
| | Chromium (+6) | 1.768 | 1.776 | 0.008 |
| | Chromium (+3) | 0.273 | 0.248 | -0.025 |
| | Phthalyde | 0.141 | 0.000 | -0.141 |
| | Naphthoquinone | 0.000 | 0.011 | 0.011 |
| | Total | 5,946.772 | 3,701.541 | -2,245.231 |
| 5. | OXO Dept. | | | |
| | Carbon monoxide | 3.564 | 3.177 | -0.387 |
| | Methane | 23.763 | 21.214 | -2.549 |
| | Butanol | 23.763 | 21.214 | -2.549 |
| | Butyraldehyde | 0.004 | 0.004 | 0.000 |
| | Total | 51.094 | 45.609 | -5.485 |
| 6. | Urea and Urea Adhesives Dept. | | | |
| | Ammonia | 0.000 | 3,830.034 | 3,830.034 |
| | Urea dust | 200.098 | 262.758 | 62.660 |
| | Dust of chromopol | 23.682 | 25.414 | 1.732 |
| | Formaldehyde | 1.867 | 1.481 | -0.386 |
| | Methanol | 41.208 | 35.619 | -5.589 |
| | Total | 266.855 | 4,155.306 | 3,888.451 |
| Total for ZAK | | 24,068.630 | 22,607.093 | -1,461.537 |



40

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Environmental Protection Dept.

Table No. 3.

Figures for basic loads of pollutants carried in waste waters disposed to the Odra River

| Pos. | Specification | Loads of pollutants (Mg) | | Changes (Mg) | Changes ( % ) | Share of load collected from Odra to that disposed ( % ) | |
|---|---|---|---|---|---|---|---|
| | | 1990 | 1991 | | | 1990 | 1991 |
| 1. | BOD 5 | 3,778.5 | 1,764.6 | -2.013.90 | -53.30 | 0.00 | 6.38 |
| 2. | COD (dichrom. method) | 5,355.3 | 4,166.8 | -1,188.50 | -22.19 | 27.20 | 24.48 |
| 3. | COD (permang. value) | 1,143.1 | 998.8 | -144.30 | -12.62 | 23.20 | 18.17 |
| 4. | Ammonium-derived nitrogen | 3,168.2 | 3,464.7 | 296.50 | 9.36 | 1.20 | 1.70 |
| 5. | Suspension | 937.4 | 1,153.8 | 216.40 | 23.09 | 81.30 | 87.39 |
| 6. | Phenols | 0.326 | 0.283 | -0.04 | -13.19 | 83.40 | 53.44 |
| 7. | Chlorides | 11,310.1 | 10,209.1 | -1.101.00 | -9.73 | 89.70 | 76.52 |
| 8. | Sulphides | 2,899.6 | 2,241.0 | -658.60 | -22.71 | 82.606 | 74.69 |
| 9. | Chromium (+3) | 0.683 | 1.110 | 0.43 | 62.52 | 51.10 | 48.4[illegible] |
| 10. | Copper | 4.710 | 4.460 | -0.25 | -5.31 | 56.00 | 10.9[illegible] |
| 11. | Soluble matter | 27,690.5 | 23,507.6 | -4,182.90 | -15.11 | 92.10 | 70.93 |
| 12. | Amount of waste water ($m^3$) | 24,999,389 | 24,259,027 | -740,362.00 | -2.96 | | |



41

Table No. 4.

Specification of wastes

| Pos. | Type of waste | Amounts (Mg) | |
|---|---|---|---|
| | | 1990 | 1991 |
| 1. | Ash and slag (+ 30 % water) | 186,760.5 | 207,320.3 |
| 2. | Spent chromium-copper-zinc-aluminium catalyst | 52.0 | 0 |
| 3. | Spent chromium-zinc catalyst | 56.0 | 0 |
| 4. | Spent alumina gel | 2.0 | 2.2 |
| 5. | Spent nickel catalyst | 0 | 110.0 |
| 6. | Nickel catalyst on alumina gel | 4.0 | 0 |
| 7. | Spent iron-chromium catalyst | 0 | 91.1 |
| 8. | Spent iron catalyst | 0 | 145.6 |
| 9. | Spent copper-zinc catalyst | 0 | 10.2 |
| 10. | Overdue resins | 200.0 | 27.8 |
| 11. | Cation exchanger powder | 8.0 | 4.0 |
| 12. | Filtration sludge | 135.0 | 44.3 |
| 13. | Deposits from a trap | 7.4 | 2.2 |
| 14. | Deposits from drinking water treatment | 80.0 | 138.0 |
| 15. | Coagulation deposits | 602.5 | 818.0 |
| 16. | Deposits from sewage treatment plant | 1,566.9 | 1,468.0 |
| 17. | Distillation residue | 1,399.0 | 1,169.2 |
| 18. | Post-carbide mud | 94.2 | 66.6 |
| | **Total** | 190,967.5 | 211,604.3 |



42

ATTACHMENT #5

Dział Ochrony Środowiska

Opłaty za korzystanie ze środowiska i wprowadzanie w nim zmian
w 1994r w rozbiciu na poszczególne produkty

| Lp | Produkt | Emisja (AIR) w tys. zł. | Ścieki (WASTEWATER) w tys. zł. | Odpady (SOLID WASTE) w tys. zł. | Razem (TOTAL) w tys. zł. |
|---|---|---|---|---|---|
| 1 | Para wodna | 6114567 | 697531 | 2073203 | 8885301 |
| 2 | Energia elektryczna | - | 484593 | - | 484593 |
| 3 | Kwas azotowy techniczny | 1906986 | 197593 | - | 2104579 |
| 4 | Azotyn sodu | 1908 | 30346 | - | 32254 |
| 5 | Azotan sodu | 85483 | 29704 | - | 115187 |
| 6 | Saletrzak | 51450 | - | - | 51450 |
| 7 | Saletra amonowa | 32905 | - | - | 32905 |
| 8 | Salmag | 63050 | 31044 | - | 94094 |
| 9 | Mączka dolomitowa | 2966 | - | - | 2966 |
| 10 | Mocznik nawozowy | 733980 | 64376 | - | 798356 |
| 11 | R-r mocznika do prod klejów | 2403 | 17561 | - | 19964 |
| 12 | Suchy i ciekły CO2 | - | 3412 | - | 3412 |
| 13 | Chromopol suchy | 253658 | 1703 | - | 255361 |
| 14 | Żywica M-1 | 7 | 522 | 1 | 530 |
| 15 | Silekol W-1,S-1,SE | 49012 | 1275448 | 4154 | 1328614 |
| 16 | Melmo PW, SM | 1476 | 99963 | 75 | 101514 |
| 17 | Silekol M-1, MZ, FO,M-2 | 15714 | 779096 | 774 | 795584 |
| | w tym Silekol M-1,M-2 | | 731470 | 771 | 732241 |
| 18 | Destylat metanolu | 54 | - | - | 54 |
| 19 | Formalina | 16230 | - | - | 16230 |
| 20 | Amoniak | 4340 | 471697 | 30912 | 506949 |
| 21 | Bezwodnik ftalowy II | 191808 | 6082125 | 16236 | 6290169 |
| 22 | Bezwodnik ftalowy III | 391885 | 8140348 | 3690 | 8535923 |
| 23 | Bezwodnik maleinowy | 62419 | 553551 | - | 615970 |
| 24 | Sulfobursztynian | 43 | - | - | 43 |
| 25 | Katalizator K1M2 | 3 | - | - | 3 |
| 26 | Ftalan dwubutylu | 1011 | 1753559 | 558 | 1755128 |
| 27 | Ftalan dwuoktylu | 14820 | 7345448 | 3978 | 7364246 |
| 28 | Octan butylu | 535 | 273125 | - | 273660 |
| 29 | Karbasil K-1 | 1473 | 12305 | - | 13778 |
| 30 | Woski twarde | 61592 | 131508 | - | 193100 |
| 31 | Woski półtwarde | 1231 | 1191 | 396 | 2818 |
| 32 | Wosken K-1U | 581 | 3906 | - | 4487 |
| 33 | Wosken K-2E | 217 | 2994 | - | 3211 |
| 34 | Chromopol r-r | 9035 | 31226 | - | 40261 |
| 35 | Poreks F | 3490 | - | - | 3490 |
| 36 | Melaform WM-100 | 83 | - | - | 83 |
| 37 | Melaform PM-80 | 2 | - | - | 2 |
| 38 | Kationity | 6190 | 200394 | 720 | 207304 |
| 39 | Aminy tłuszczowe | 225 | 30922 | - | 31147 |
| 40 | Komponent benzynowy | 3022 | - | - | 3022 |
| 41 | Alkohole nasycone | - | 11627 | 0 | 11627 |
| 42 | Alkohole nienasycone | - | 7937 | 0 | 7937 |
| 43 | Stearyna łojowa c.(dest.,niedest.) | - | 3011 | - | 3011 |
| 44 | Silesian | 67 | - | - | 67 |
| 45 | Antimnol WMS | 87 | 26947 | 26 | 27060 |
| 46 | Melasil P | 51 | 78156 | 591 | 78798 |
| 47 | Melasile K-1, K-2 | 619 | 1261039 | 2703 | 1264361 |
| 48 | Melafob S | 5 | 18050 | - | 18055 |
| 49 | Metoksol K-1 | 315 | 130852 | 118 | 131285 |
| 50 | Płyn PZ | 450 | 73112 | - | 73562 |
| 51 | Utrwalacz IS | 1208 | - | - | 1208 |
| 52 | Katenol K-50 | - | 4535 | - | 4535 |
| 53 | Oktanol | 5788 | 2562060 | - | 2567848 |
| 54 | N-butanol | 849 | 15853 | - | 16702 |
| 55 | Izo-butanol | 1080 | 18800 | - | 19880 |
| 56 | Kwas cyjan.techniczny | - | 23400 | - | 23400 |
| 57 | Kwas fumarowy spożywczy | - | 36739 | - | 36739 |
| 58 | Kwas fumarowy czysty | - | 2163 | - | 2163 |
| 59 | Utwardzacz DOK-1 | - | 10807 | - | 10807 |
| 60 | Upłynniacz SK-1 | 6 | - | - | 6 |
| 61 | Woda sanitarna | - | - | 1380 | 1380 |
| 62 | Woda przemysłowa | - | 167999 | 8180 | 176179 |
| 63 | Woda zdemineralizowana | - | 200080 | - | 200080 |
| 64 | Woda częściowo zdemineralizowana | - | 33074 | - | 33074 |
| 65 | Woda zmiękczona | - | 16346 | - | 16346 |
| 66 | Woda wstępnie oczyszczona | - | 22641 | - | 22641 |
| 67 | Oczyszczanie ścieków | - | 1053869 | 287664 | 1341533 |
| 68 | ZBA | - | - | 666 | 666 |
| | Σ | 10.3 | 34,5 | 23 | 59,5 |