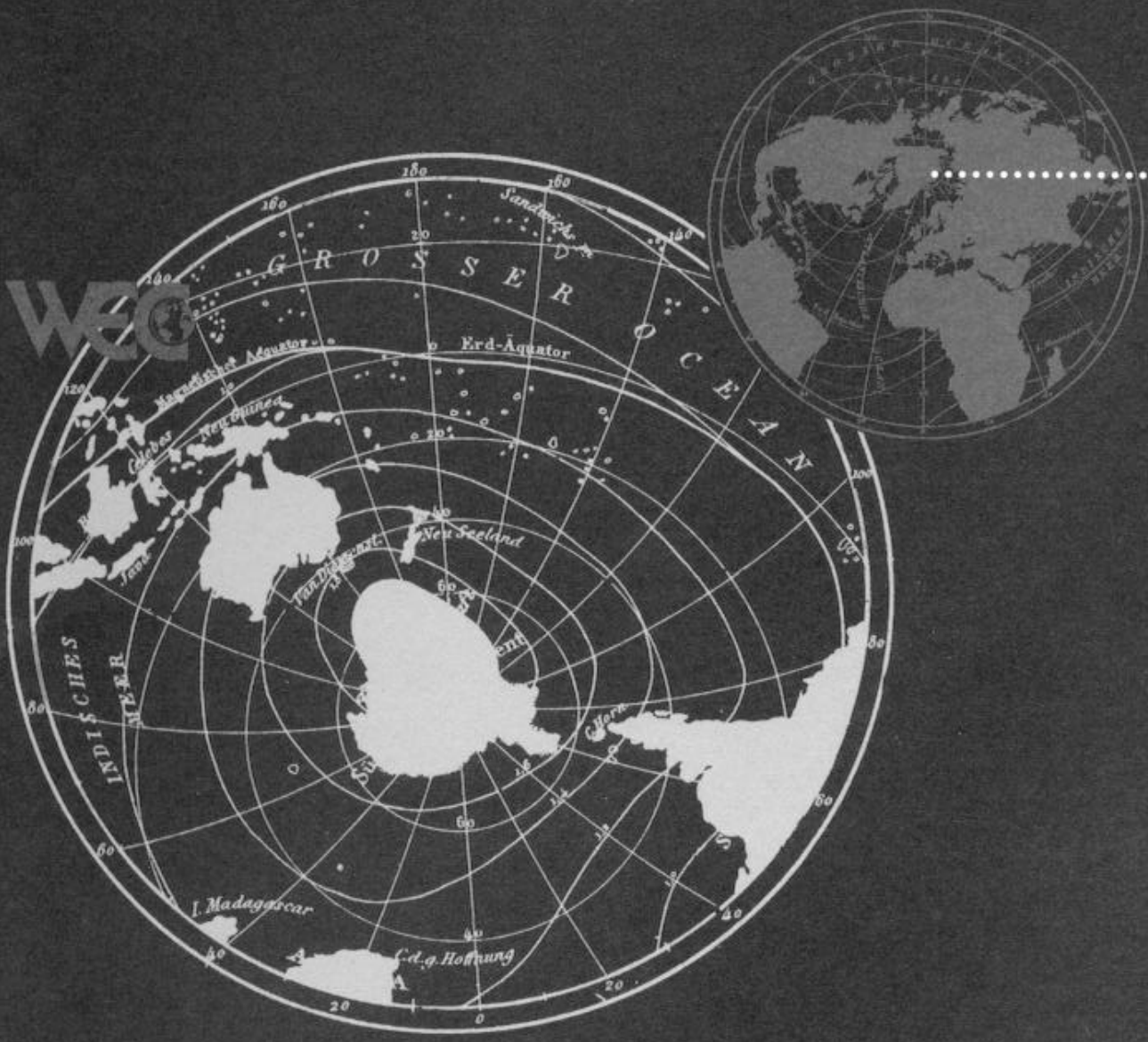
WORLD ENVIRONMENT CENTER



ECONOMIC AND ENVIRONMENTAL BENEFITS OF INDUSTRIAL WASTE MINIMIZATION IN POLAND

About the World Environment Center

The World Environment Center is an independent, not-for-profit, non-advocacy organization which contributes to sustainable development worldwide by strengthening industrial and urban environment, health and safety policy and practices. Over three decades, WEC has quietly evolved into an effective, proactive and hands-on organization by innovatively linking the "four Es" -- environment, energy, education and economics. Through three complementary programs -- the International Environment Forum (IEF), the International Environment and Development Service (IEDS) and the WEC Gold Medal for International Corporate Environmental Achievement -- WEC serves as a bridge for exchange of information and expertise among the industry, government, non-governmental organizations and the community. WEC is headquartered in New York City with offices in Bangkok, Jakarta, Mexico City, Prague and Washington, D.C.

In its waste minimization programs, WEC uses experts from U.S. organizations, including the following companies that participate in the International Environment Forum:

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ECONOMIC AND ENVIRONMENTAL BENEFITS OF INDUSTRIAL WASTE MINIMIZATION IN POLAND

1995

The Industrial Waste Minimization Program in Poland is conducted by the World Environment Center (WEC) under the management of Romuald Michalek, Vice President, Technical Programs. WEC staff who contributed to the success of the program include Danello Cabico, Project Assistant; Greg Cannon, Project Coordinator; Karen Fidler, Project Manager; Dr. George Laszkiewicz, Project Manager; Thomas Pluta, Program Manager; Prabodh Shah, Project Manager and Henryk Sojka, WEC Coordinator in Poland.

Funding for the program is provided through a cooperative agreement with the United States Agency for International Development (USAID). In particular WEC acknowledges Mr. Michael Kalinoski, Industrial Pollution Specialist, USAID, Washington, D.C. and Mr. Andrzej Pecikiewicz, Project Specialist, USAID, Warsaw for their guidance and direction in the implementation of the program.

EXECUTIVE SUMMARY

Since 1992, the World Environment Center (WEC) has worked in Poland to demonstrate the economic benefits of environmentally motivated low-cost waste minimization and cleaner production measures. This report summarizes the results of 52 waste minimization projects implemented at 18 companies representing the chemical, pharmaceutical, non-ferrous metals, meat processing, and dairy industrial sectors.

WEC's Industrial Waste Minimization Program in Poland, with financial support from the United States Agency for International Development (USAID), saved the 18 participating companies about US $8 million per year. Because savings of a similar magnitude will continue in future years, the economic benefits gained by the companies are more appropriately expressed in terms of Net Present Value (NPV). Altogether, the NPV of the economic benefits for the 52 waste minimization projects at the 18 companies has been calculated at $24.6 million. This is based upon an average project life of eight years, a dollar discount rate of 10 percent, and a corporate tax rate of 40 percent.

By decreasing the use of resources such as water, energy, and raw materials, and by reducing the generation of waste materials, the companies significantly improved their productivity, environmental performance, and worker health and safety. A summary of environmental benefits resulting from the 52 waste minimization projects is presented in Table 1. Indeed, substantial reductions in releases to air, water, and land were achieved by the 18 companies. Additional environmental benefits associated with decreased water, energy, and raw material usage were also realized. Information on specific environmental benefits of individual projects are presented in the main section of this report.

The participating companies realized significant economic benefits from the 52 waste minimization projects, as illustrated in Figure 1. To implement these projects, WEC contributed about $203,000 for capital investment. As a result of this investment, companies achieved an estimated annual savings of $1.6 million. Moreover, most of the participating companies adopted the WEC waste minimization and cleaner production philosophy and methodology, investing an additional $1.35 million in various waste minimization projects. Company investments resulted in annual savings of over $6.4 million. From the total investment of $1.55 million, the total savings to the companies were $8 million. The investments made and the savings achieved by the companies demonstrate the overwhelming success of WEC's program to "institutionalize" a waste minimization management culture in Polish industries.

As shown in Figures 2 and 3, the benefits at the participating companies were achieved largely through activities requiring low-cost investments and short payback periods. For example, 80 percent of investments were below $25,000 with payback periods of less than six months. Figure 4 illustrates the broad range of waste minimization activities implemented.

The main section of this report includes a summary list of the 52 waste minimization projects followed by one-page descriptions of these projects.

The results of the WEC program provide a compelling financial case for waste minimization and cleaner production. In the current phase of the program, WEC is continuing the "institutionalization" of waste minimization activities in these and other industry sectors in cooperation with three Pollution Prevention Centers in Poland. Not only will this strategy achieve environmental and economic benefits in the future, it will also contribute to the restructuring and privatization process of the Polish industry.

Table 1 Estimates of Environmental Benefits for 52 Waste Minimization Projects*

AIR

Air Pollutant	Emission Reduction (tons/year)
Ammonia	1,010
Particulates (not including metals)	960
Hydrocarbons	530
Particulates (including zinc, lead, cadmium and other metals)	390
Vinyl chloride	60
Sulfur dioxide (SO_2), nitrogen oxides(NO_x), and carbon monoxide (CO)	significant[1]

WATER

Water Pollutant	Discharge Reduction (tons/year)
Wastewater (containing metals and other contaminants)	1,530,000
Sodium hydroxide	5,400
Sulfuric acid	3,800
Chemical oxygen demand (COD)	1,050
Biological oxygen demand (BOD)	55

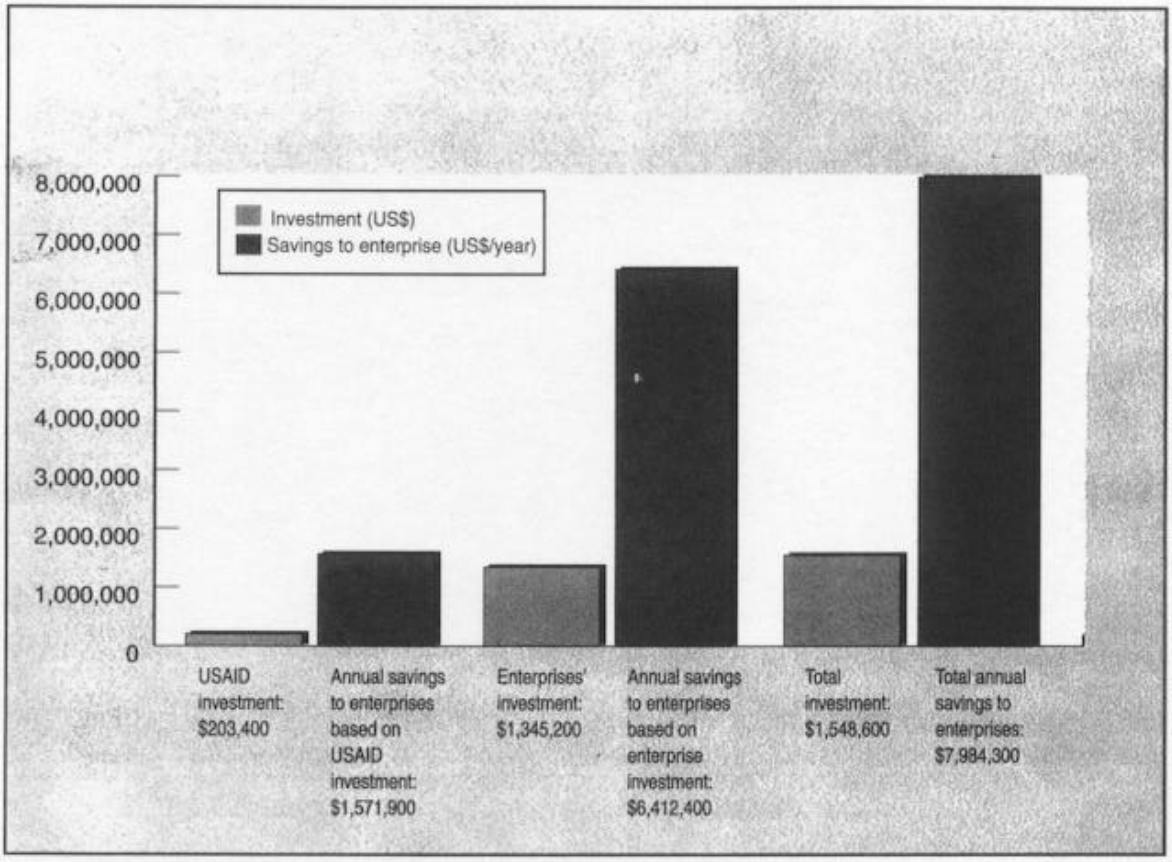
LAND

Waste Material	Disposal Reduction (tons/year)
Sulfuric acid	45,000
Electrolytes	9,000
Sludge (containing metals)	1,350
Miscellaneous hazardous waste	1,025

[1] Energy conservation activities associated with many of the waste minimization projects are projected to result in significant reductions in SO_2, NO_x, and CO emissions from reduced fossil fuel combustion.

* The reductions in environmental releases to air, water and land presented above reflect estimates based on available data for each of the 52 waste minimization projects. Additional environmental benefits associated with decreased water, energy, and raw material usage were also realized. Detailed information on specific environmental benefits of individual waste minimization projects are presented in the main section of this report.

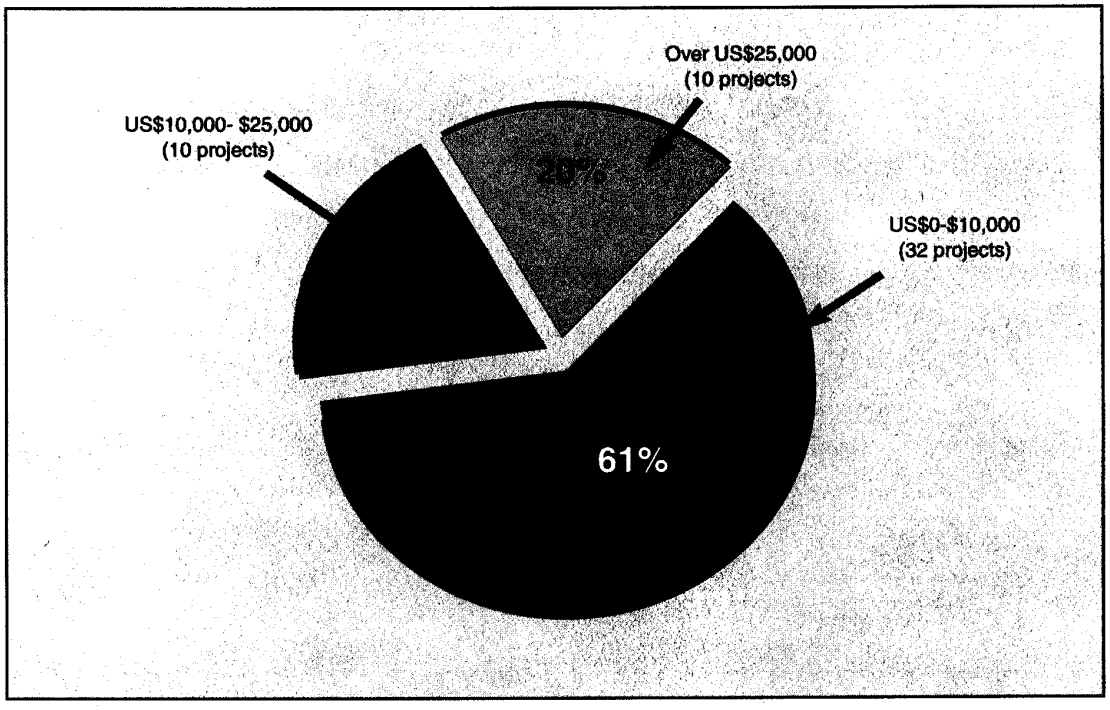
Figure 1 Summary of Investments and Economic Benefits for 52 Waste Minimization Projects*



Source	Investment (US$)	Savings to Enterprises (US$/year)
USAID	203,400	1,571,900
Enterprises	1,345,200	6,412,400
Total	1,548,600	7,984,300

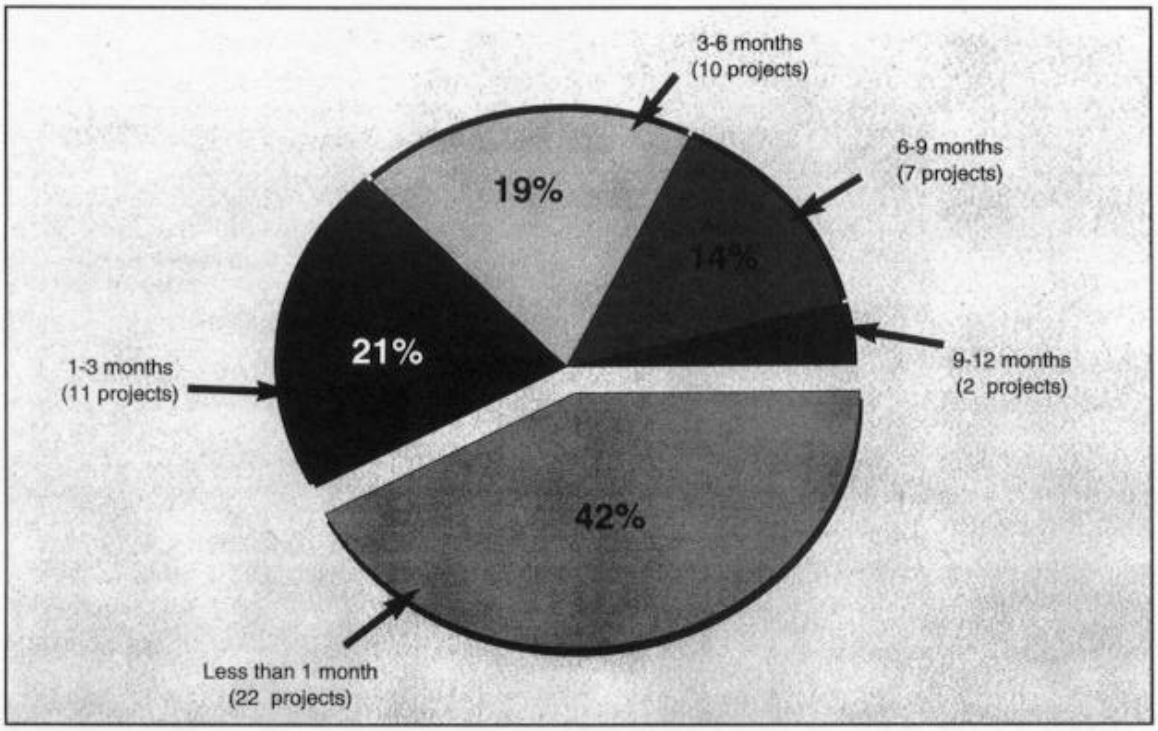
* This figure presents a summary of investments by U.S. Agency for International Development (USAID) and the enterprises for the 52 waste minimization projects along with the corresponding annual savings by the 18 enterprises in the first year following project implementation. Savings of a similar magnitude will continue in future years. The net present value (NPV) of the total savings is estimated to be US$24.6 million, based on an average project life of eight years, a dollar discount rate of 10 percent and a corporate tax rate of 40 percent.

Figure 2 Range of Investments for 52 Waste Minimization Projects



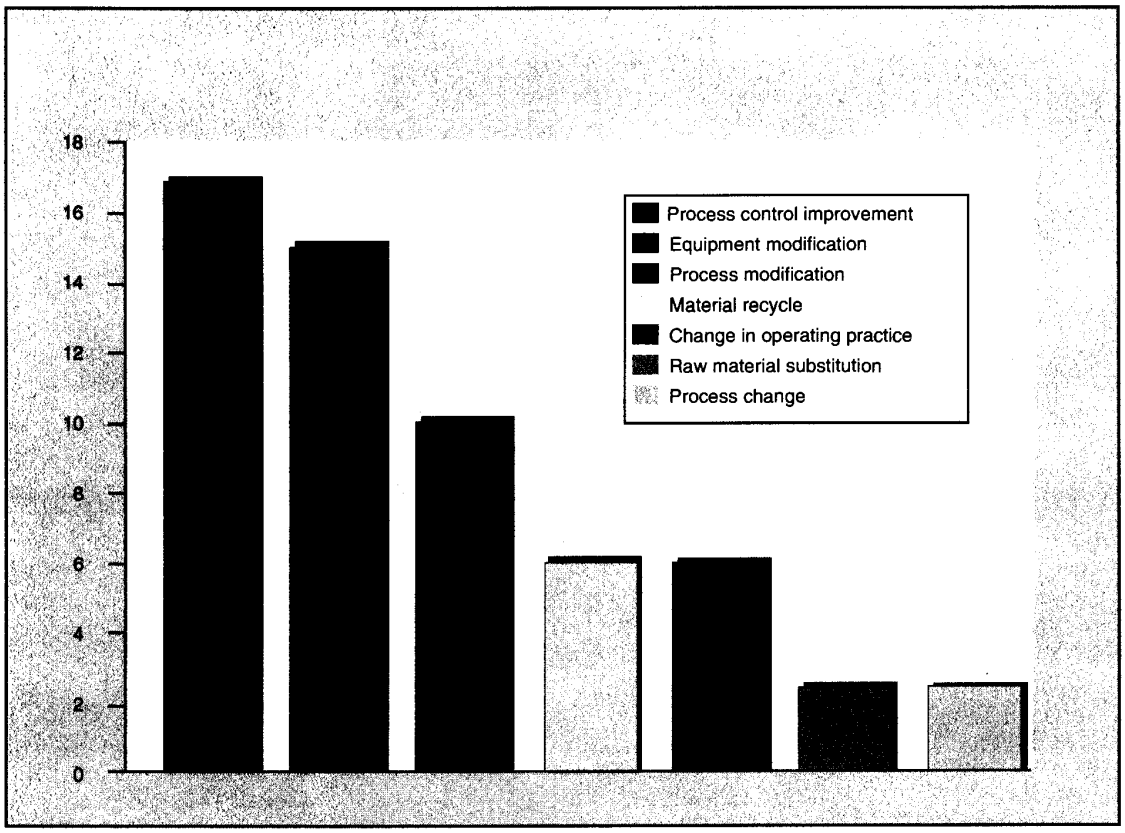
0 - 1	7	13
1 - 5	17	33
5 - 10	8	15
10 - 25	10	19
25 - 50	5	10
50 - 100	2	4
100 - 500	2	4
> 500	1	2
Total	52	100

Figure 3 Summary of Payback Periods for 52 Waste Minimization Projects



Payback Period (months)	Number of Projects	% of Total Projects
< 1	22	42
1 - 3	11	21
3 - 6	10	19
6 - 9	7	14
9 - 12	2	4
Total	52	100

Figure 4 Types of Waste Minimization Activities Implemented



Process Control Improvement	17
Equipment Modification	15
Process Modification	10
Material Recycle	6
Change in Operating Practice	6
Raw Material Substitution	2
Process Change	2

(1) Some of the 52 waste minimization projects involved more than one type of waste minimization activity.

52 INDUSTRIAL WASTE MINIMIZATION PROJECTS

IN POLAND

SUMMARY OF
52 INDUSTRIAL WASTE MINIMIZATION PROJECTS IN POLAND

Page No.	Plant Name/ Location	Description of Waste Minimization Project *Activity Type*	Investment ($)	Annual Savings ($/year)	Payback Period (Months)
1	Nitrogen Works Kedzierzyn, Kedzierzyn	Formalin Plant Improves Process Efficiency and Reduces Air Emissions *Change in Operating Practice*	None[a,b]	19,600	0
2	"	Argon Plant Eliminates Air Emissions *Change in Operating Practice*	330[b]	19,800	< 1
3	"	Benfield Potash Lye Plant Reduces Water Consumption and Wastewater Discharges *Equipment Modification*	1,400[b]	30,500	< 1
4	"	Phthalic Anhydride Plant Improves Product Yield and Decreases Emissions *Process Modification*	2,000[b]	55,200	< 1
5	"	Partial Oxidation Plant Eliminates Air Emissions and Wastewater Discharges *Equipment Modification*	2,260[b]	2,880	9
6	"	Formalin Plant Eliminates Land Disposal of Hazardous Waste *Equipment Modification*	2,700[b]	71,400	< 1
7	"	Urea Synthesis Plant Eliminates Wastewater Discharge *Process Modification*	18,900[b]	106,000	2
8	"	Urea Plant Saves Raw Materials and Reduces Emissions *Equipment Modification; Change in Operating Practice*	40,100[b]	89,000	< 6
9	"	Ammonia Plant Saves Fuel and Decreases Air Emissions *Process Control Improvement*	14,500[a] 1,800[b]	25,100	< 8
10	Chemical Works Organika-Zachem, Bydgoszcz	Epichlorohydrin Plant Reduces Waste *Process Modification*	1,250[b]	13,750	< 2
11	"	Dye Plant Improves Product Yield and Decreases Waste *Process Modification*	2,500[b]	15,000	2

[a] Investment by USAID
[b] Investment by Enterprise

SUMMARY OF
52 INDUSTRIAL WASTE MINIMIZATION PROJECTS IN POLAND (CONT'D)

Page No.	Plant Name/ Location	Description of Waste Minimization Project *Activity Type*	Investment ($)	Annual Savings ($/year)	Payback Period (Months)
12	Chemical Works Organika-Zachem, Bydgoszcz (Cont'd)	Epichlorohydrin Plant Saves Raw Materials and Reduces Wastewater Discharges *Material Recycle*	7,200[b]	109,200	< 1
13	"	Toluenediisocyanate Plant Saves Raw Materials and Reduces Wastewater Discharges *Equipment Modification*	99,800[b]	258,000	< 5
14	"	Epichlorohydrin Plant Reduces Steam and Energy Usage *Process Modification; Equipment Modification*	120,000[b]	252,000	< 6
15	"	Toluenediisocyanate Plant Increases Process Efficiency and Reduces Waste *Process Change*	622,000[b]	1,055,000	7
16	"	Epichlorohydrin Plant Reduces Water Usage and Wastewater Discharges *Process Control Improvement*	4,600[a]	92,000	< 1
17	"	Dye Plant Saves Raw Materials and Reduces Wastewater Discharges *Process Control Improvement*	5,000[a] 2,000[b]	180,000	< 1
18	"	Chemical Plant Reduces Steam Consumption *Process Control Improvement*	12,100[a]	84,000	< 2
19	Chemical Works Blachownia, Kedzierzyn-Kozle	Coke Tar Recovery Plant Decreases Operating Costs and Reduces Waste *Equipment Modification*	None[a,b]	25,700	0
20	"	Carbochemical Plant Reduces Water Consumption and Wastewater Discharges *Material Recycle*	400[b]	53,000	< 1
21	"	Carbochemical Plant Saves Energy and Reduces Air Emissions *Equipment Modification*	900[b]	18,500	< 1

[a] Investment by USAID
[b] Investment by Enterprise

SUMMARY OF
52 INDUSTRIAL WASTE MINIMIZATION PROJECTS IN POLAND (CONT'D)

Page No.	Plant Name/ Location	Description of Waste Minimization Project *Activity Type*	Investment ($)	Annual Savings ($/year)	Payback Period (Months)
22	Chemical Works Blachownia, Kedzierzyn-Kozle (Cont'd)	Benzol Recovery Plant Saves Energy and Reduces Waste *Process Modification*	11,500[b]	255,000	< 1
23	"	Benzol Recovery Plant Increases Process Efficiency and Reduces Waste Generation *Process Control Improvement*	12,000[a] 13,200[b]	157,000	2
24	Organika-Azot Chemical Works, Jaworzno	Dichloroacetophenone Plant Improves Product Yield and Reduces Waste Generation *Process Modification*	800[b]	11,900	< 1
25	"	Pesticides Plant Reduces Water Consumption and Wastewater Discharges *Material Recycle*	1,050[b]	21,600	< 1
26	"	Dichloroacetophenone Plant Saves Raw Materials and Reduces Wastewater Discharges *Material Recycle*	1,100[b]	13,000	1
27	"	Pesticides Plant Saves Energy and Reduces Water Consumption *Process Control Improvement*	5,965[a]	19,500	< 4
28	Polchem Chemical Works, Torun	Liquid Waste Neutralization System Reduces Sludge Disposal and Saves Raw Materials *Material Recycle*	2,700[b]	3,600	9
29	"	Lime Milk Preparation Process Reduces Water Consumption and Wastewater Discharges *Material Recycle*	3,850[b]	9,500	< 5
30	"	Boiler Feed Water Preparation Process Reduces Water and Lime Consumption *Process Modification*	10,350[b]	14,500	< 9
31	"	Chlorosulfonic Plant Eliminates Waste Disposal and Saves Raw Materials *Process Change*	8,500[a] 242,000[b]	1,100,000	< 3

[a] Investment by USAID
[b] Investment by Enterprise

SUMMARY OF
52 INDUSTRIAL WASTE MINIMIZATION PROJECTS IN POLAND (CONT'D)

Page No.	Plant Name/ Location	Description of Waste Minimization Project *Activity Type*	Investment ($)	Annual Savings ($/year)	Payback Period (Months)
32	Boruta S.A. Dyestuff Industry Works, Zgierz	Sodium Sulfate Recovery Plant Increases Material Recycle and Reduces Wastewater *Process Control Improvement*	1,793[a]	27,500	< 1
33	"	Wastewater Treatment Plant Increases Waste Recycling and Reduces Wastewater *Process Control Improvement*	1,794[a]	31,200	< 1
34	"	Sodium Bisulfite Plant Saves Raw Materials and Reduces Wastewater *Raw Material Substitution; Process Control Improvement*	1,833[a]	31,800	< 1
35	Chemical Works Oswiecim, Oswiecim	Polyvinyl Chloride Plant Improves Yield and Reduces Air Emissions *Process Modification; Equipment Modification*	31,400[b]	2,100,000	< 1
36	"	Polyvinyl Chloride Plant Reduces Air Emissions *Process Control Improvement*	9,700[a]	34,800	< 4
37	Boryszew S.A. Chemical and Plastics Company, Sochaczew	Vegetable Oil Plant Decreases Wastewater Discharges *Raw Material Substitution*	8,600[b]	165,000	< 1
38	"	Dibutyl Maleate Plant Reduces Wastewater Discharges *Process Modification; Process Control Improvement*	15,600[a] 4,400[b]	48,100	5
39	Inorganic Works Bonarka, Krakow	Animal Feed Production Plant Saves Raw Materials and Decreases Air Emissions *Process Control Improvement*	9,600[a]	247,000	< 1
40	Viscoplast S.A., Wroclaw	Solvent Recovery Plant Increases Waste Recycling and Reduces Air Emissions *Process Control Improvement*	10,600[a] 7,900[b]	19,360	< 12
41	Pharmaceutical Works Polfa, Tarchomin	Butyl Acetate Regeneration Plant Saves Raw Materials *Change in Operating Practice*	100[b]	12,000	< 1

[a] Investment by USAID
[b] Investment by Enterprise

SUMMARY OF
52 INDUSTRIAL WASTE MINIMIZATION PROJECTS IN POLAND (CONT'D)

Page No.	Plant Name/ Location	Description of Waste Minimization Project *Activity Type*	Investment ($)	Annual Savings ($/year)	Payback Period (Months)
42	Pharmaceutical Works Polfa, Tarchomin (Cont'd)	Ryfamycin Plant Improves Process Efficiency and Reduces Releases *Equipment Modification; Change in Operating Practice*	51,000[b]	198,000	< 4
43	"	Pharmaceutical Plant Reduces Air Emissions *Change in Operating Practice*	4,500[a] 5,500[b]	88,000	< 2
44	Metallurgical Works Silesia, Katowice	Zinc Melting Furnace Improves Process Efficiency and Decreases Waste *Process Control Improvement*	24,380[a] 2,120[b]	77,500	< 5
45	Mining and Metallurgical Enterprise Boleslaw, Bukowno,	Metal Leaching Operation Improves Process Efficiency and Decreases Waste *Process Control Improvement*	15,000[a] 12,000[b]	204,030	< 2
46	Hutmen S.A., Wroclaw	Copper Plant Improves Process Efficiency and Decreases Waste *Process Control Improvement*	12,600[a] 2,200[b]	243,700	< 1
47	Agryf Meat Plant,	Meat Plant Saves Water and Reduces	10,000[a]	80,000	< 2
47	Szczecin	Wastewater Discharges *Equipment Modification*	19,000[b]	80,000	< 2
48	Lmeat Meat Plant, Lukow	Meat Plant Saves Water and Reduces Wastewater Discharges *Equipment Modification*	9,900[a] 4,800[b]	160,000	< 2
49	Garwolin Dairy, Garwolin	Dairy Plant Reduces Wastewater Discharges *Process Control Improvement*	2,590[a]	3,480	9
50	"	Dairy Plant Reduces Water Use and Wastewater Discharges *Equipment Modification*	6,450[a]	10,400	7.5
51	Zakopane Dairy, Zakopane	Dairy Plant Saves Steam and Reduces Energy Use *Equipment Modification*	2,200[a]	15,600	< 2
52	"	Dairy Plant Reduces Water Use and Wastewater Discharges *Equipment Modification*	2,250[a]	5,100	5

[a] Investment by USAID.
[b] Investment by Enterprise

Change in Operating Practices at Formalin Plant Improves Process Efficiency and Reduces Air Emissions

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	0	0	$19,600	immediate

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Methanol	22 tons/yr	-	-	27.5 tons/yr
Formaldehyde	5.5 tons/yr	-	-	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

One of the products manufactured at the Nitrogen Works is formalin. In the first step of the formalin production process, a methanol-water mixture is evaporated and saturated with air. In the second step, the saturated mixture is fed into a reactor where it passes over a heated silver or copper catalyst. The reactor outlet gases are absorbed in water and marketed under the name of formalin, a 40 percent solution of formaldehyde containing some methanol.

During start-up operations when the evaporation reaction is unstable, air is not introduced into the system. In the past, water was not supplied into the absorption column during this start-up period. This operating practice resulted in large releases of methanol and formaldehyde to the atmosphere. During the waste minimization project, a comprehensive process investigation showed that economic and environmental benefits could be gained by changing this operating practice, i.e., by supplying water and operating the absorption column during start-up.

The waste minimization project did not require any capital expenditures or additional labor. In addition to reducing air emissions, the project decreased the plant's consumption of methanol by 27.5 tons/year and reduced the amount of environmental fees paid by the plant.

Equipment: None required

Completion Date: October 1994

Change in Operating Practices at Argon Plant Eliminates Air Emissions

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	330	330	19,800	1 week

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Methane	177,000 m^3/yr	-	-	177,000 m^3/yr

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

Two argon production plants at the Nitrogen Works produce a methane fraction (containing about 98 percent methane). When the argon plants are in operation, the methane fraction streams are transferred to the OXY-alcohol process where they are used to prepare a synthetic gas (syn-gas) and hydrogen. In the past, during periods when the OXY-alcohol plant is shut down, the methane fraction streams from the argon plants were vented directly to the atmosphere at an average rate of approximately 450 m^3/hour. On an annual basis, the methane losses amounted to 177,000 m^3.

During the waste minimization project, new piping and valves were installed to vent the methane fraction during the OXY alcohol process shut-down periods to a fuel gas collector. This change in operating procedure reduced emissions to the atmosphere, while utilizing the caloric value of the methane fraction on-site at the ammonia plant or at the boiler house.

Equipment: Piping, valves
Cost - $330 (by Nitrogen Works)

Completion Date: July 1994

Equipment Modification at Benfield Potash Lye Plant Reduces Water Consumption and Wastewater Discharges

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	1,400	1,400	30,500	< 3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	197,000 m^3/yr
Wastewater	-	197,000 m^3/yr	-	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

The Nitrogen Works operates a Benfield Potash Lye plant. In the potash lye regeneration process, carbon dioxide is cooled in a two-segment water cooler from 110°C to 30°C. In the past, about 20 tons/hour of condensate containing potassium carbonate and carbon dioxide were discharged into the sewer from both segments of the cooler.

During the waste minimization project, it was determined that after separation of the condensates from the two cooler segments, the condensate from the second segment can be reused in the process. The implementation of the project required minor equipment modifications. As a result of the project, the plant reduced discharges of wastewater to the sewer, while reducing water consumption. The project also reduced the amount of environmental fees paid by the plant.

Equipment: Equipment modifications
Cost - equipment: $400, labor - $1,000 (by Nitrogen Works)

Completion Date: July 1994

Process Modification at Phthalic Anhydride Plant Improves Product Yield and Decreases Emissions

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	2,000	2,000	55,700	2 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Phthalic anhydride	31,400 kg/yr	-	-	-
Maleic anhydride	320 kg/yr	-	-	-
Benzoic anhydride	210 kg/yr	-	-	-
Naphthalene	30 kg/yr	-	-	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

The Nitrogen Works produces phthalic anhydride among its many products. In the past, the venting system of the phthalic anhydride refining units was maintained at 200°C using pressurized steam. At this temperature, the vapor pressure of phthalic anhydride and other organic compounds is high and consequently product losses and significant emissions of organics into the atmosphere occurred.

During the waste minimization project, other heating media for maintaining the venting system were evaluated. A decision was made to replace the pressurized steam at 200°C with steam condensate at 135°C which is available at the plant site. By decreasing the venting system's temperature from 200°C to 135°C, the vapor pressures and consequently the emissions of organics decreased substantially. In addition to reducing emissions to the atmosphere, the project improved the plant's product yield and reduced the amount of environmental fees paid by the plant.

Equipment: Liquid pump, piping, insulation (available at the plant)
Cost - equipment: $1,500, labor: $500 (by Nitrogen Works)

Completion Date: August 1994

Equipment Modification at Partial Oxidation Plant Eliminates Air Emissions and Wastewater Discharges

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	2,260	2,260	2,880	9 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	7,100 m^3/year
Condensate/recirculation water	-	7,100 m^3/year	-	-
Post-reaction gases	Yes	-	-	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

Post-reaction gases from the partial oxidation plant undergo cooling from 200° C in water-cooled heat exchangers. Condensate from the exchangers was discharged through a hand-operated valve directly to the sewer. When the valve was left open too wide, post-reaction gases were emitted to the atmosphere. In addition, when heat exchanger seals became unsealed, large volumes of recirculation waters were discharged to the sewer.

During the waste minimization project, an evaluation of the post-reaction cooling process was undertaken with the objective of eliminating emissions of post-reaction gases to the atmosphere and discharges of condensate and recirculation waters to the sewer. This was accomplished by the installation of a liquid seal type degasifier. As a result, condensate is now safely discharged into recirculation waters and emissions of post-reaction gases into the atmosphere were eliminated.

Equipment: Liquid seal type gasifier
Cost - equipment: $600, labor: $1,660 (by Nitrogen Works)

Completion Date: July 1994

Equipment Modification at Formalin Plant Eliminates Land Disposal of Hazardous Waste

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	2,700	2,700	71,400	2 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Heavy organic waste	-	-	350 m^3	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

The Nitrogen Works produces a formalin product consisting of a 37 percent aqueous solution of formaldehyde. Since 1975, the formalin product is stored in four tanks. Over time, about 350 m^3 of heavy tank bottoms accumulate in the tanks and must be removed. In the past, the procedure to remove the tank bottoms was difficult and extremely expensive. Once removed, the tank bottoms were disposed in a hazardous waste landfill. Alternative procedures were needed because of diminishing landfill capacity and high environmental fees for toxic waste disposal.

During the waste minimization project, a new procedure was developed to first dissolve the polymer bottom material followed by subsequent processing to recover formalin. The new procedure utilizes a hot distillation residue from the Urea Adhesive plant and steam to dissolve the bottoms. The solution of bottom polymers dissolved in the hot residue is then utilized in the absorption process in the manufacture of formalin.

To complete the project, pipelines to deliver steam and residues from the Urea Adhesive plant to the formalin plant were installed. As a result of the project, disposal of 350 m^3 of hazardous waste was eliminated. The project also reduced the amount of environmental fees paid by the plant and potential liability posed by land disposal of hazardous waste.

Equipment: Piping, valves (available at plant)
Cost - $2,700 (by Nitrogen Works)

Completion Date: March 1995

Process Modification at Urea Synthesis Plant Eliminates Wastewater Discharge

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	18,900	18,900	106,000	2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Ammonia	-	500 tons/yr	-	500 tons/yr

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

The urea synthesis plant at the Nitrogen Works uses a solution with the following composition: ammonia - 40.3 percent; carbon dioxide - 29.4 percent; urea - 9.2 percent; and water - 21.1 percent. The temperature of the solution is 90°C. Special type Halberg pumps are used to pump this solution into autoclaves. Because crystallization of the solution occurs at 75°C, water is supplied to the pumps to wash safety valves, plunger stuffing boxes, and other equipment and piping in the system. The generated wastewater, containing 500 tons/year of ammonia, was previously collected and discharged into the sewer.

For the waste minimization project, experiments were conducted with the objective of eliminating discharges of wastewater to the sewer. The results of the experiments indicated that the wastewater could be reused in the absorption system in the urea plant. New piping, valves, and pumps were installed to complete the project. As a result of the process modifications, discharges of wastewater to the sewer were eliminated. The project also reduced the amount of environmental fees paid by the plant.

Equipment: Pumps, piping, valves
Cost - equipment: $12,500, labor: $6,400 (by Nitrogen Works)

Completion Date: August 1994

Modifications to Equipment and Operating Practices at Urea Plant Save Raw Materials and Reduce Emissions

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	40,100	40,100	89,000	< 6 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Ammonia	1,000 tons/yr	-	-	400 tons/yr
Demineralized water	-	-	-	1,300 m^3/yr

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

Urea is one of the many products manufactured at Nitrogen Works. In the last step of the urea production process, urea is concentrated from 65 percent up to 69 percent in a vaporizer. During this step, a vapor stream composed primarily of water, ammonia, and carbon dioxide passes from the evaporator to a cooler-condenser. In the past, the condensate with an ammonia concentration of about 290 grams per liter was expanded through a control valve and transferred to an atmospheric tank connected to the stack. During expansion, significant amounts of gaseous ammonia were lost to the atmosphere. The remaining condensate containing about 190 grams/liter of ammonia was then mixed with urea wastewater and utilized as a reflux stream in the absorption column.

During the waste minimization project, operating procedures were changed to reduce the ammonia losses into the atmosphere. This was accomplished by installing a pump to transfer the condensate under pressure from the cooler directly to the urea absorption column. This equipment modification enabled the condensate to be used in place of ammonia water which previously had to be produced from demineralized water and gaseous ammonia supplied from the ammonia synthesis plant.

Implementation of this waste minimization activity decreased ammonia losses into the atmosphere by 132 kg/hour, saved 1,300 m^3/year of demineralized water, and decreased consumption of ammonia by 400 tons/year.

Equipment: Liquid pump; Supplier - Local
Cost - equipment: $33,600, labor: 6,500 (by Nitrogen Works)

Completion Date: July 1994

Better Process Control at Ammonia Plant Saves Fuel and Decreases Air Emissions

Company: Nitrogen Works Kedzierzyn
City: Kedzierzyn
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
14,500	1,800	16,300	25,100	< 8 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fuel gas	-	-	-	250,000 m^3/yr
Nitrogen oxides	Yes	-	-	-
Carbon monoxide	Yes	-	-	-

Company Profile

Construction of the Nitrogen Works in Kedzierzyn began in 1940 on the ruins of an industrial facility owned by the German company, "IG Farben Industries." Production activity at the site expanded significantly in 1954, when new plants were commissioned to produce ammonia, nitric acid, nitro-chalk, and other products. At present, the Nitrogen Works operates over 50 chemical plants producing over 110 products in the following groups: nitrogen fertilizers, adhesive resins, technical gases, components for plastics, other intermediate products, and specialty chemicals. The Nitrogen Works also manufactures high quality OXY-alcohols.

Waste Minimization Project

The Nitrogen Works produces a synthesis gas for its ammonia plant. The synthesis gas is produced by oxidation of natural gas in two separate heaters. The heaters are fired with a mixture of natural gas and coke oven gas. Previously, the heating system was not equipped with any monitoring or control equipment. In addition, there were no sampling ports to collect gas samples at the inlet and outlet of the heaters. The combustion system was inefficient, used too much fuel, and generated excess emissions of nitrogen oxides and carbon monoxide.

During the waste minimization project, a comprehensive evaluation of the heating system indicated that the efficiency of the combustion system could be improved by the installation of appropriate carbon monoxide/oxygen monitoring equipment and sampling ports.

As a result of the project, necessary information is available to operate the combustion system at optimum conditions. The project resulted in savings of about 250,000 m^3/year of fuel gas and reductions in emissions of nitrogen oxides and carbon monoxide to the atmosphere.

Equipment: CO/O_2 Combustion Control System, Model WDG-HPIIC
Supplier - AMETEK, Pittsburgh, PA
Cost - equipment $14,500 (by USAID), equipment and labor: $1,800 (by Nitrogen Works)

Completion Date: August 1995

Process Modification at Epichlorohydrin Plant Reduces Waste

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	1,250	1,250	13,750	5 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Allyl chloride	24 tons/yr	-	-	-

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

The production of epichlorohydrin (EPI) at "Organika-Zachem" is generally based on the following reaction:

$$\text{Propylene} + \text{Chlorine} + \text{Lime} + \text{Water} \rightarrow \text{EPI}$$

In the first phase of the reaction, allyl chloride is formed. In the second phase, not all of the allyl chloride is converted to EPI. In the past, the unconverted allyl chloride became part of the chloroorganic wastes and was incinerated in a special furnace.

During the waste minimization project, the overall EPI process was evaluated with the objective to increase product yield and decrease waste generation. Trial runs confirmed that substantial amounts of allyl chloride present in the chloroorganic wastes can be recovered in an existing distillation column and reused in the EPI production process. Implementation of the project required only small piping changes. As a result of the project, the facility reduced its chloroorganic wastes.

Equipment: Piping; Supplier - local
Cost - equipment: $300, labor: $950 (by "Organika-Zachem")

Completion Date: May 1994

Process Modification at Dye Plant Improves Product Yield and Decreases Waste

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	2,500	2,500	15,000	2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	0.7 ton O_2 [(a)]	-	-
Miscellaneous waste	-	1.4 tons[(a)]	-	-

[(a)] per ton of product

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

"Organika-Zachem" utilizes about 80 technologies in the manufacture of dyes and semiproducts. Technology modifications in the manufacture of Heliofor-type dyes were needed to improve product yield and decrease waste generation.

During the waste minimization project, the Heliofor dye plant operations were reviewed and laboratory tests were conducted to determine the optimum process conditions for product yield improvement. As a result of the investigation, some process parameters were changed and a surface active agent was introduced into the production process. These changes in the Heliofor dye production process resulted in reductions in raw materials usage and associated improvements in product yield. As a result of the project, the facility also reduced chemical oxygen demand (COD) discharges to water and other wastes.

Equipment: None

Completion Date: August 1994

Material Recycle at Epichlorohydrin Plant Saves Raw Materials and Reduces Wastewater Discharges

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	7,200	7,200	109,200	< 1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Calcium salts	-	208 tons/yr	-	-
Steam	-	-	-	5,400 tons/yr
Fresh water	-	-	-	70,800 m^3/yr

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

The production of epichlorohydrin (EPI) at "Organika-Zachem" is generally based on the following reaction:

$$\text{Propylene} + \text{Chlorine} + \text{Lime} + \text{Water} \rightarrow \text{EPI}$$

In the past, the wastewater generated in the EPI production process contained significant amounts of calcium salts.

During the waste minimization project, a process optimization program was conducted to improve process efficiency. A process was identified and implemented to recover calcium salts from process wastewater and reprocess them into calcium hydroxide (lime). The latter is used as a raw material in the hydrolysis process during EPI manufacture. The project resulted in raw material savings and reductions in wastewater discharges.

Equipment: Process equipment; Supplier - local
Cost - equipment: $2,400, labor: $4,800 (by "Organika-Zachem")

Completion Date: May 1993

Equipment Modification at Toluenediisocyanate Plant Saves Raw Materials and Reduces Wastewater Discharges

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	99,800	99,800	258,000	< 5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	135 tons O_2/yr	-	-
Fresh water	-	-	-	300,000 m^3/yr
Steam	-	-	-	11,250 tons/yr

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

At "Organika-Zachem," toluenediisocyanate (TDI) synthesis is conducted in the presence of a neutral dichlorobenzene solvent. The product purification step is accomplished under vacuum distillation. In the past, a steam-water ejector system was used to develop the necessary vacuum. This system required excessive amounts of steam and water. In addition, significant amounts of product and reactants were discharged with wastewater from the vacuum distillation columns.

During the waste minimization project, an analysis was conducted to identify methods for decreasing steam and water usage, as well as product and reactant losses at the TDI plant. A decision was made to replace the steam-water ejector system with a special mechanical vacuum pump system. The latter system uses dichlorobenzene, a process solvent, as a sealant in the vacuum pumps. The solvent, after absorbing traces of product and reactants from the distillation columns, is recycled into the TDI synthesis reactor. Implementation of this project resulted in a substantial decrease in water and steam use and in recovery and reuse of valuable materials previously discharged into the sewers.

Equipment: High quality vacuum pumps; Supplier - Hick Hargreaves, England
Cost - $99,800 (by "Organika-Zachem")

Completion Date: February 1994

Process and Equipment Modifications at Epichlorohydrin Plant Reduce Steam and Energy Usage

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	120,000	120,000	252,000	< 6 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Steam	-	-	-	12,000 tons/yr
Sulfur dioxide (SO_2)	21.5 tons/yr	-	-	-

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

The production of epichlorohydrin (EPI) at "Organika-Zachem" is generally based on the following reaction:

Propylene + Chlorine + Lime + Water → EPI

Due to the highly exothermic reaction of the EPI production process, substantial volumes of hot water were discharged in the past to the sewer. At the same time, significant amounts of steam were used elsewhere in the process to preheat raw materials entering the distillation columns.

During the waste minimization project, a detailed evaluation of the water and steam usage at the EPI plant was conducted. Based on the findings of the evaluation, the facility purchased and installed a plate-type heat exchanger at the EPI plant to recover the heat energy from the hot process wastewater and utilize it to preheat raw materials to the distillation columns. The project resulted in reductions in steam and energy usage.

Equipment: Plate-type heat exchanger; Supplier - local
Cost - $120,000 (by "Organika-Zachem")

Completion Date: December 1994

Process Change at Toluenediisocyanate Plant Increases Process Efficiency and Reduces Waste

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	622,000	622,000	1,055,000	7 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Waste tar	-	-	22 kg[(a)]	-

[(a)] per ton of product

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

During the synthesis of toluenediisocyanate (TDI) at "Organika-Zachem," large quantities of after-distillation tars were produced in the past. These tars contained significant amounts of valuable TDI product and were disposed in a landfill at the plant site.

During the waste minimization project, a technical and financial feasibility analysis was conducted to evaluate the possibility of TDI product recovery from the after-distillation tars. Based on positive results of laboratory experiments and pilot plant tests, a special-type evaporator for heavy tars distillation was purchased from a Swiss company. Implementation of this project resulted in a significant improvement in product yield and a substantial decrease in waste tar generation.

Equipment: Evaporator for heavy tars distillation; Supplier - List, Switzerland
Cost - $622,000 (by "Organika-Zachem")

Completion Date: October 1994

Better Process Control at Epichlorohydrin Plant Reduces Water Usage and Wastewater Discharges

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
4,600	0	4,600	92,000	< 3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	150,000 m^3/yr
Chemical oxygen demand	-	70 tons O_2/yr	-	-

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

The production of epichlorohydrin (EPI) at "Organika-Zachem" is generally based on the following reaction:

Propylene + Chlorine + Lime + Water → EPI

In this production process, the exothermic reaction and reagent concentrations must be carefully controlled to maximize product yield. In the past, this production line did not operate under optimum conditions resulting in excessive volumes of water consumption, product losses, and wastewater discharges.

During the waste minimization project, a process optimization program was conducted to improve product yield, decrease water use, and reduce waste generation. The optimum process conditions were defined and a conclusion was reached that the primary obstacle for process optimization was the lack of a fast and reliable method for the determination of the chemical oxygen demand (COD) in the wastewater discharged from the EPI plant. The COD analytical methods were slow, unreliable, and strongly biased by a high chlorine content in the wastewater.

In order to alleviate the COD analytical problems, a spectrophotometer was purchased and installed. This instrument provides frequent and reliable COD analyses which are completed in a substantially shorter period of time. This information allows operating personnel to adjust process conditions in order to operate the EPI plant at optimum levels. The waste minimization project resulted in product yield improvements of 0.4 percent, substantial reductions in water usage and wastewater discharges, and decreased environmental fees.

Equipment: Spectrophotometer DR2000; Supplier - HACH Company, Loveland, CO; Cost - $4,600 (by USAID)

Completion Date: December 1993

Better Process Control at Dye Plant Saves Raw Materials and Reduces Wastewater Discharges

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
5,000	2,000	7,000	180,000	2 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	30 tons O_2/yr	-	-
Sulfuric acid	-	-	-	2,800 tons/yr
Sodium hydroxide	-	-	-	5,400 tons/yr

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

"Organika-Zachem" utilizes about 80 technologies in the manufacture of dyes and semiproducts. In these manufacturing processes, careful control of the pH level at consecutive steps during production is critical to optimize product yield and process economics. In the past, pH control was carried out by a trial and error approach with grab samples sent to a laboratory for analysis. Plant personnel reported difficulties achieving pH control, mainly due to unreliable equipment and the long delay to obtain results from a distant laboratory.

During the waste minimization project, a review of the dye plant operating records revealed that the same processes conducted in the same batch tanks and with the same chemicals frequently resulted in different product yields and volumes of generated wastes. Further investigation identified a strong correlation between frequent pH adjustment and product yield. As a result of the investigation, three acid resistant pH meters were purchased and installed at specific locations in the process. The project resulted in raw material savings and reductions in wastewater discharges.

Equipment: Acid resistant pH meters; Supplier - Electro-Chemical Devices, Inc., Orange, CA
Cost - equipment: $5,000 (by USAID), labor: $2,000 (by "Organika-Zachem")

Completion Date: December 1993

Better Process Control at Chemical Plant Reduces Steam Consumption

Company: Chemical Works "Organika-Zachem" **City:** Bydgoszcz
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
12,100	0	12,100	84,000	< 2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Steam	-	-	-	3,900 tons/yr
Sulfur dioxide (SO_2)	7 tons/yr	-	-	-

Company Profile

"Organika-Zachem" is a large chemical company in Bydgoszcz. The company sells products to domestic and foreign markets for use in the following industrial sectors: automobile, furniture, electrical, textiles, and chemical. The number of employees is 2,500. Production facilities at "Organika-Zachem" are grouped in four plants: synthesis, plastics, dyes, and foams. Major products include chlorine, epichlorohydrin, toluenediisocyanate, polyesters, polyurethane foams, polyvinyl chloride, insulation compounds, synthetic dyes, soda lye, sodium phosphate, hydrochloric acid, and dinitrotoluene.

Waste Minimization Project

"Organika-Zachem" receives steam for its process and heating requirements from the power plant in Bydgoszcz. In the past, the accounting of steam allocations to individual users was based on annual agreements and flat rate payments. This procedure provided no incentive for users to adopt practices within their operations which would reduce steam consumption.

During the waste minimization project, a detailed analysis of steam distribution and usage was performed. It was found that steam consumption could be decreased if steam monitoring devices were installed on piping distribution systems to make individual plants accountable for their steam use. Two steam monitoring devices, controlled by microprocessors, were purchased and installed on two 250 mm steam distribution lines. One system was installed in a line delivering steam to a production plant located in the eastern part of the "Organika-Zachem" complex; the other system was installed in a line which delivers steam to a number of contracting firms.

Installation of the two steam monitoring devices provided for improved control of steam consumption and accountability of individual users. This in turn motivated all users to conserve steam usage. As a result, "Organika-Zachem" decreased its consumption of steam by 3,900 tons/year in 1994.

Equipment: Steam monitoring devices; Supplier - Honeywell Company, Minneapolis, MN
Cost - $12,100 (by USAID)

Completion Date: March 1994

Equipment Modification at Coke Tar Recovery Plant Decreases Operating Costs and Reduces Waste

Company: Chemical Works "Blachownia" **City:** Kedzierzyn-Kozle
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	0	0	25,700	immediate

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Coke waste	-	-	130 tons/yr	-

Company Profile

Chemical Works "Blachownia" is located in the Southern part of Poland, near the Upper Silesian industrial region. The factory was built on the ruins of a German chemical complex, which produced synthetic aircraft gasoline during the Second World War. One of the largest Polish producers of chemicals, "Blachownia" has been offering a wide range of chemical products for domestic and foreign markets for over 40 years. Today, the company manufactures products derived from coal and coke, petrochemicals, polyethylene, and chemical synthesis products. The plant employs almost 3,000 people.

Waste Minimization Project

At "Blachownia," wastewater from the coke tar recovery plant contains significant amounts of tar compounds. The wastewater passes through two layers of coke filters where the tars are collected. In the past, the coke filter media containing tar compounds was combusted in an incinerator. Because over-fired coke could not be reused as feed to the filters, the facility was required to purchase 130 tons/year of new coke to replace the spent filter media. The filter media exchange operations, including tar combustion, lasted two to three months. Moreover, the required coke for the filter media is relatively expensive.

During the waste minimization project, it was determined that bales of compressed rye or wheat could be substituted for coke as the filter media for the coke tar recovery process. Implementation of this project significantly decreased filter media and operating costs, improved working conditions for plant operators, and eliminated over-fired coke waste.

Equipment: None

Completion Date: July 1995

Material Recycle at Carbochemical Plant Reduces Water Consumption and Wastewater Discharges

Company: Chemical Works "Blachownia" **City:** Kedzierzyn-Kozle
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	400	400	53,000	< 1 week

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	114,000 m^3/yr
Wastewater	-	114,000 m^3/yr	-	-

Company Profile

Chemical Works "Blachownia" is located in the Southern part of Poland, near the Upper Silesian industrial region. The factory was built on the ruins of a German chemical complex, which produced synthetic aircraft gasoline during the Second World War. One of the largest Polish producers of chemicals, "Blachownia" has been offering a wide range of chemical products for domestic and foreign markets for over 40 years. Today, the company manufactures products derived from coal and coke, petrochemicals, polyethylene, and chemical synthesis products. The plant employs almost 3,000 people.

Waste Minimization Project

In the sanitary water conditioning process at "Blachownia," generated wash water undergoes sedimentation for removal of suspended solids prior to discharge to the central wastewater treatment plant. The volume of wash water handled in this process averages 114,000 m^3/year.

During the waste minimization project, reuse of wash water in the cooling water loop of the carbochemical plant was investigated and found to be feasible. Implementation of the project resulted in a decrease in consumption of fresh water by 114,000 m^3/year. The amount of wash water discharged to the facility's central wastewater treatment was also reduced by the same amount.

Equipment: None required

Completion Date: August 1994

Equipment Modification at Carbochemical Plant Saves Energy and Reduces Air Emissions

Company: Chemical Works "Blachownia" **City:** Kedzierzyn-Kozle
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	900	900	18,500	< 3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Naphthalene	1,200 kg/year	-	-	-
Power	-	-	-	7,875 kWh/yr
Steam	-	-	-	800 tons/yr

Company Profile

Chemical Works "Blachownia" is located in the Southern part of Poland, near the Upper Silesian industrial region. The factory was built on the ruins of a German chemical complex, which produced synthetic aircraft gasoline during the Second World War. One of the largest Polish producers of chemicals, "Blachownia" has been offering a wide range of chemical products for domestic and foreign markets for over 40 years. Today, the company manufactures products derived from coal and coke, petrochemicals, polyethylene, and chemical synthesis products. The plant employs almost 3,000 people.

Waste Minimization Project

During the distillation process of coke tars at "Blachownia," one of the recovered fractions is naphthalene oil. The naphthalene oil fraction is initially stored in two intermediate tanks from which it is pumped periodically to two storage tanks at the tar distillation plant. After an appropriate amount of naphthalene is accumulated, it is then transferred to a large storage tank at the naphthalene distillation plant for further processing. This operating practice of frequent pumping between the two storage areas and finally into the naphthalene distillation plant resulted in significant naphthalene losses and excessive steam and power consumption needed for heating of storage tanks and collector pipes at the tar distillation plant.

During the waste minimization project, an equipment modification was implemented which decreased the naphthalene losses and saved steam and energy. The modification involved the elimination of one storage tank at the tar distillation plant and the installation of a direct pipeline between the intermediate storage tanks at the tar distillation plant and naphthalene oil distillation plant. As a result of this project, the facility reduced naphthalene emissions to the atmosphere by 1,200 kg/year. In addition, the facility reduced its power consumption by 7,875 kWh/year and its steam consumption by 800 tons/year.

Equipment: Piping with steam tracing
Cost - $900 (by "Blachownia")

Completion Date: November 1994

Process Modification at Benzol Recovery Plant Saves Energy and Reduces Waste

Company: Chemical Works "Blachownia" **City:** Kedzierzyn-Kozle
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	11,500	11,500	255,000	< 3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Hazardous waste	600 tons/yr	-	-	-
Fuel	-	-	-	Yes

Company Profile

Chemical Works "Blachownia" is located in the Southern part of Poland, near the Upper Silesian industrial region. The factory was built on the ruins of a German chemical complex, which produced synthetic aircraft gasoline during the Second World War. One of the largest Polish producers of chemicals, "Blachownia" has been offering a wide range of chemical products for domestic and foreign markets for over 40 years. Today, the company manufactures products derived from coal and coke, petrochemicals, polyethylene, and chemical synthesis products. The plant employs almost 3,000 people.

Waste Minimization Project

Heavy organic wastes formed in "Blachownia's" benzol recovery plant undergo neutralization followed by coagulation with aluminum sulfate. After suspension separation, the wastes are sent to the central wastewater treatment plant. During this operation, about 600 tons/year of sediment is formed which is periodically incinerated in rotary burners. The sediment handling process is extremely troublesome and expensive. It involves the removal of tar sediment from settling tanks, transportation to the rotary burner, and significant fuel requirements. In addition, because the high sodium content in the sediment causes melting of the furnace lining during combustion, the furnace lining must be replaced four times per year.

During the waste minimization project, experiments were conducted to identify a more efficient procedure for the treatment of wastes from the benzol recovery plant. To implement the project, an aeration system was installed as part of the preliminary waste purification process. A collection system carries the air containing traces of organics to special catalytic burners for incineration. This process modification eliminated the incineration of sediments and significantly decreased operating costs.

Equipment: Piping for air supply, collection system for aeration off gas
Cost - $11,500 (by "Blachownia")

Completion Date: July 1995

Better Process Control at Benzol Recovery Plant Increases Process Efficiency and Reduces Waste Generation

Company: Chemical Works "Blachownia" **City:** Kedzierzyn-Kozle
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
12,000	13,200	25,200	157,000	2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Sulfuric acid	-	-	-	5 kg[(a)]
Waste tar	-	-	Yes	-

[(a)] per ton of product

Company Profile

Chemical Works "Blachownia" is located in the Southern part of Poland, near the Upper Silesian industrial region. The factory was built on the ruins of a German chemical complex, which produced synthetic aircraft gasoline during the Second World War. One of the largest Polish producers of chemicals, "Blachownia" has been offering a wide range of chemical products for domestic and foreign markets for over 40 years. Today, the company manufactures products derived from coal and coke, petrochemicals, polyethylene, and chemical synthesis products. The plant employs almost 3,000 people.

Waste Minimization Project

The raw benzol recovery process at "Blachownia" involves a number of distillation and separation operations. In order to operate the distillation processes at optimum efficiency, it is necessary to select the most appropriate process parameters, i.e., feed and reflux rate, temperature, and pressure. To accomplish this, continuous information about the exact composition of all process streams must be known. In the past, the process stream compositions were analyzed by simple distillation procedures which did not provide fast and reliable information for complex mixtures containing many compounds.

During the waste minimization project, it was determined that a special type gas chromatograph could provide necessary information on the process stream composition. As a result, a Hewlett Packard gas chromatograph was purchased and is currently being used. The fast and reliable information about the composition of process streams has increased the yield of benzene, toluene, and light resin from raw benzol by 0.2 percent, 0.3 percent, and 0.1 percent, respectively. In addition, the facility has reduced its consumption of sulfuric acid from 85 to 80 kg/ton of product.

Equipment: Gas chromatograph, Type HP-5890, Series II, with accessories
Supplier - Hewlett Packard Company, Wilmington, DE
Cost - $25,200 ($12,000 by USAID, $13,200 by "Blachownia")

Completion Date: July 1995

Process Modification at Dichloroacetophenone Plant Improves Product Yield and Reduces Waste Generation

Company: "Organika Azot" Chemical Works
Industry: Chemical
City: Jaworzno
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	800	800	11,900	< 1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Organic waste	-	-	1,500 kg/yr	-
Miscellaneous raw materials	-	-	-	4,500 kg/yr

Company Profile

"Organika Azot" is a leading manufacturer of pesticides in Poland as well as other crop protection products and sanitary agents for agriculture. The company was founded in 1917 and initially produced fertilizers. Today, the plant employs 800 people and produces a wide variety of chemicals including insecticides, herbicides, and fungicides. Products are formulated and packaged at the plant. There is a synthesis plant for organochlorophosphates and a reaction facility for copper oxychloride manufacture. Other manufacturing lines produce aerosol containers and polyethylene packaging. Products are primarily marketed in Poland, but some are exported to Holland.

Waste Minimization Project

During the manufacture of the insecticide "Birlane," one of the process steps is the distillation of raw dichloroacetophenone (DCAP). During the distillation step, heavy organic wastes containing about 50 percent (by weight) of DCAP are generated. In the past, all organic wastes were combusted in an on-site incinerator.

During the waste minimization project, a comprehensive evaluation of the DCAP production process was performed. The results indicated that economic and environmental benefits could be realized by redistillation of a part of the organic waste generated during the first distillation of raw DCAP.

As a result of the project, the facility is recovering 7.5 kg DCAP/ton of product and has reduced the amount of organic waste incinerated. The facility's raw material requirements have also been decreased by 4,500 kg/year.

Equipment: Pump, piping (available at plant)
Cost - $800 (by "Organika-Azot")

Completion Date: September 1994

Material Recycle at Pesticides Plant Reduces Water Consumption and Wastewater Discharges

Company: "Organika Azot" Chemical Works
City: Jaworzno
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	1,050	1,050	21,600	< 3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Wastewater	-	150,000 m^3/yr	-	-
Fresh water				150,000 m^3/yr

Company Profile

"Organika Azot" is a leading manufacturer of pesticides in Poland as well as other crop protection products and sanitary agents for agriculture. The company was founded in 1917 and initially produced fertilizers. Today, the plant employs 800 people and produces a wide variety of chemicals including insecticides, herbicides, and fungicides. Products are formulated and packaged at the plant. There is a synthesis plant for organochlorophosphates and a reaction facility for copper oxychloride manufacture. Other manufacturing lines produce aerosol containers and polyethylene packaging. Products are primarily marketed in Poland, but some are exported to Holland.

Waste Minimization Project

During normal operations, "Organika-Azot" needed to purchase about 500,000 m^3/year of water to satisfy the requirements of all production plants. Process wastewater generated at the facility underwent primary and biological treatment in the existing wastewater treatment plant before discharge into a nearby river.

During the waste minimization project, the feasibility of recycling and reusing a part of the treated wastewater in selected processes was investigated. The results of the investigation indicated that about 150,000 m^3/year of treated wastewater could be reused in specific operations. Implementation of the project resulted in a decrease in the purchase requirements for fresh water of 150,000 m^3/year. The facility also reduced wastewater discharges by 150,000 m^3/year and paid less environmental fees.

Equipment: Pump, piping; Supplier - Local
Cost - $1,050 (by "Organika-Azot")

Completion Date: September 1994

Material Recycle at Dichloroacetophenone Plant Saves Raw Materials and Reduces Wastewater Discharges

Company: "Organika Azot" Chemical Works
City: Jaworzno
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	1,100	1,100	13,000	1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Wastewater	-	1.8 $m^{3(a)}$	-	-
Miscellaneous raw materials	-	-	-	Yes

(a) per ton of product

Company Profile

"Organika Azot" is a leading manufacturer of pesticides in Poland as well as other crop protection products and sanitary agents for agriculture. The company was founded in 1917 and initially produced fertilizers. Today, the plant employs 800 people and produces a wide variety of chemicals including insecticides, herbicides, and fungicides. Products are formulated and packaged at the plant. There is a synthesis plant for organochlorophosphates and a reaction facility for copper oxychloride manufacture. Other manufacturing lines produce aerosol containers and polyethylene packaging. Products are primarily marketed in Poland, but some are exported to Holland.

Waste Minimization Project

Dichloroacetophenone (DCAP) is an intermediate material in the production process of the insecticide "Birlane." During the production process, DCAP is first hydrolyzed and then extracted with benzene. Subsequently, the benzene organic phase containing the DCAP is subjected to a three-step washing operation. During this washing operation, wastewater containing aluminum salts is generated. In the past, some of the wastewater was sold as a 25 percent solution of aluminum chloride, but the majority (second and third step washings) was discharged into the wastewater treatment plant.

During the waste minimization project, experiments confirmed that the wastewater from the second and third washings of the organic phase of DCAP could be reused in the hydrolysis process and replace fresh water. Implementation of this project resulted in raw material savings and in decreased wastewater discharges and environmental fees.

Equipment: Piping, aluminum chloride pump (available at plant)
Cost - $1,100 (by "Organika-Azot")

Completion Date: September 1994

Better Process Control at Pesticides Plant Saves Energy and Reduces Water Consumption

Company: "Organika Azot" Chemical Works
Industry: Chemical
City: Jaworzno
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
5,965	0	5,965	19,500	< 4 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	7,000 m^3/yr
Energy	-	-	-	Yes

Company Profile

"Organika Azot" is a leading manufacturer of pesticides in Poland as well as other crop protection products and sanitary agents for agriculture. The company was founded in 1917 and initially produced fertilizers. Today, the plant employs 800 people and produces a wide variety of chemicals including insecticides, herbicides, and fungicides. Products are formulated and packaged at the plant. There is a synthesis plant for organochlorophosphates and a reaction facility for copper oxychloride manufacture. Other manufacturing lines produce aerosol containers and polyethylene packaging. Products are primarily marketed in Poland, but some are exported to Holland.

Waste Minimization Project

Due to a lack of appropriate monitoring equipment, "Organika-Azot" has been experiencing excessive consumption of hot water in their central heating system and fresh and industrial water throughout the plant.

During the waste minimization project, a thorough analysis of hot and fresh water distribution and usage was conducted. The results of the analysis showed that appropriate water monitoring equipment would significantly decrease the hot and industrial water consumption at the plant. Hot water is distributed through pipe branches to many buildings and spaces which need heat. Many of these branches were overheated which resulted in excessive hot water consumption and heat losses. By monitoring the hot water flow through each branch, orifices could be installed to minimize water consumption. Monitoring capabilities would also be helpful in locating leaks throughout the factory's water network by checking and comparing the water flows at both ends of the pipelines.

To implement this project, a portable liquid flow meter, with adapters for various pipe sizes, was purchased and installed. This monitoring equipment is being used by plant personnel to continuously improve management of their hot water and process water.

Equipment: Portable flow meter, Model 190P Spectra
Supplier - Controlotron, Hauppauge, NY;
Cost - $5,965 (by USAID)

Completion Date: February 1995

Reuse of Sludge in Liquid Waste Neutralization System Reduces Sludge Disposal and Saves Raw Materials

Company: "POLCHEM" Chemical Works
Industry: Chemical
City: Torun
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	2,700	2,700	3,600	9 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Sludge	-	-	204 tons/yr	-
Lime	-	-	-	10 tons/yr

Company Profile

"POLCHEM" is a chemical manufacturer specializing in the manufacture of inorganic products, particularly chlorosulfonic acid and sulfites. The company was established in 1932 and currently employs approximately 450 people. Awareness of environmental issues began in the 1960's and the plant made major process improvements in 1971, 1976 and 1979 resulting in lower environmental releases. In the 1990's, with the restructurization of industry, the plant continues investing to upgrade the facility's profitability and to improve environmental control.

Waste Minimization Project

"POLCHEM" operates a waste neutralization system, in which lime milk is used to neutralize liquid process wastes. Following neutralization, the liquid wastes are transported to a sedimentation tank. Liquid effluent from the sedimentation tank undergoes pH adjustment prior to discharge. Sludge from the sedimentation tank is disposed.

During the waste minimization project, alternatives were evaluated for optimizing the waste neutralization system to reduce the amount of wastes generated. Laboratory tests indicated that the sludge contained excess unused lime, therefore allowing it to be reused as a raw material in place of lime milk in the liquid waste neutralization process. To implement this project, piping was installed to transport the sludge from the sedimentation tank to the neutralization system. Additional instrumentation, including a flow meter and a pH meter, were also installed as part of the project.

As a result of the waste minimization project, the facility reduced its sludge disposal by 204 tons/year and reduced its lime consumption by 10 tons/year.

Equipment: Flow meter, pH meter with recorder, piping; Supplier - ISCO, Inc., Lincoln, NE;
Cost - $2,700 (by "POLCHEM")

Completion Date: May 1995

Reuse of Liquid Waste in Lime Milk Preparation Process Reduces Water Consumption and Wastewater Discharges

Company: "POLCHEM" Chemical Works
Industry: Chemical
City: Torun
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	3,850	3,850	9,500	< 5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	45,500 m^3/yr
Wastewater	-	45,500 m^3/yr	-	-

Company Profile

"POLCHEM" is a chemical manufacturer specializing in the manufacture of inorganic products, particularly chlorosulfonic acid and sulfites. The company was established in 1932 and currently employs approximately 450 people. Awareness of environmental issues began in the 1960's and the plant made major process improvements in 1971, 1976, and 1979 resulting in lower environmental releases. In the 1990's, with the restructurization of industry, the plant continues investing to upgrade the facility's profitability and to improve environmental control.

Waste Minimization Project

"POLCHEM" operates a waste neutralization system, in which lime milk is used to neutralize liquid process wastes. In the past, about 45,500 m^3/year of fresh water was used in the preparation of the lime milk.

During the waste minimization project, "POLCHEM" identified and implemented a process modification to allow substitution of selected liquid wastes for fresh water in the lime milk preparation step. Installation of a membrane pump, flow meter and pH meter was required to implement the project. As a result of this process change, the facility reduced its fresh water consumption by 45,500 m^3/year. Likewise, the volume of wastewater discharged from the liquid waste neutralization system was reduced by the same amount.

Equipment: Membrane pump, flow meter and pH meter; Supplier - Warren Pumps Inc., Mansfield, OH
Cost - $3,850 (by "POLCHEM")

Completion Date: July 1995

Process Modification at Boiler Feed Water Preparation Process Reduces Water and Lime Consumption

Company: "POLCHEM" Chemical Works
Industry: Chemical
City: Torun
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	10,350	10,350	14,500	< 9 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	200,000 m^3/yr
Lime	-	-	-	40.5 tons/yr
Used quartz sand	-	-	2.5 tons/yr	-

Company Profile

"POLCHEM" is a chemical manufacturer specializing in the manufacture of inorganic products, particularly chlorosulfonic acid and sulfites. The company was established in 1932 and currently employs approximately 450 people. Awareness of environmental issues began in the 1960's and the plant made major process improvements in 1971, 1976, and 1979 resulting in lower environmental releases. In the 1990's, with the restructurization of industry, the plant continues investing to upgrade the facility's profitability and to improve environmental control.

Waste Minimization Project

"POLCHEM" operates a quartz sand reactor ("Vibros" system) to produce decarbonated raw water for use as feed water to the KS-12 boiler. Nominal capacity of the "Vibros" system requires that the reactor be fed with at least 41 m^3/hour of raw water and 600 liters/hour of lime milk. The reactor holds 300 kg of contact mass (quartz sand), which is replaced every 15 days. The "Vibros" system produces 41 m^3/hour of decarbonated water, of which only 13.3 m^3/hour is needed for feed water to the KS-12 boiler. The remaining 27.7 m^3/hour is used as make-up water in the facility's process water system.

During the waste minimization project, "POLCHEM" redesigned the decarbonation system to recirculate a portion of the decarbonated water back into the reactor. This process modification allowed the facility to use 200,000 m^3/year of decarbonated water in place of raw water for process water use. To implement this project, the facility installed new control valves, a membrane feed pump, and related process control instrumentation.

As a result of the waste minimization project, the facility reduced its raw water consumption by 200,000 m^3/year. The facility also reduced its lime usage by 40.5 tons/year and eliminated disposal of 2.5 tons/year of used quartz sand.

Equipment: Automatic flow measurement and control unit, control valves, membrane feed pump; Supplier - Local
Cost - $10,350 (by "POLCHEM")

Completion Date: January 1995

Process Change at Chlorosulfonic Plant Eliminates Waste Disposal and Saves Raw Materials

Company: "POLCHEM" Chemical Works
Industry: Chemical
City: Torun
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
8,500	242,000	250,500	1,100,000	< 3 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Sulfuric acid	-	-	44,500 tons/yr	36,000 tons/yr
Lime	-	-	-	4,800 tons/yr

Company Profile

"POLCHEM" is a chemical manufacturer specializing in the manufacture of inorganic products, particularly chlorosulfonic acid and sulfites. The company was established in 1932 and currently employs approximately 450 people. Awareness of environmental issues began in the 1960's and the plant made major process improvements in 1971, 1976, and 1979 resulting in lower environmental releases. In the 1990's, with the restructurization of industry, the plant continues investing to upgrade the facility's profitability and to improve environmental control.

Waste Minimization Project

Chlorosulfonic acid is one of "POLCHEM's" most important products. Existing technology was very inefficient, generating three tons of waste sulfuric acid per ton of chlorosulfonic product. Because no adequate market existed for this large volume of byproduct, the facility experienced significant disposal costs.

During the waste minimization project, methods for improving product yield and decreasing waste acid generation were investigated. "POLCHEM," in cooperation with a local WEC-trained consultant (from "BIPROCHEM" A/E), developed a modified process which eliminates sulfuric acid waste generation. To test the new process technology, a pilot plant was built and manually operated. Pilot plant results indicated that additional improvements in product yield could be achieved by installing automatic process controls for temperature, pressure, and flow in place of manual controls. Subsequently, a full-scale production line, including automatic process control equipment, was constructed and is now in operation.

As a result of the waste minimization project, the facility eliminated 44,500 tons/year of sulfuric acid waste and reduced consumption of raw materials, including 36,000 tons/year of technical grade sulfuric acid (previously used in the preparation of water-free 100 percent hydrochloric acid) and 4,800 tons/year of lime (previously used for neutralization of waste sulfuric acid).

Equipment:

Pilot and full-scale plant equipment and installation; Supplier - Local
Cost - $242,000 (by "POLCHEM")
Flowmeter DNW-10, DP transmitter STD110, controller DC300K and control valve BP79PM; Supplier - Valve & Controls Division of Power and Pumps Inc.,Orlando, FL
Cost - $8,500 (by USAID)

Completion Date: July 1995

Better Process Control at Sodium Sulfate Recovery Plant Increases Material Recycle and Reduces Wastewater

Company: "BORUTA" S.A. Dyestuff Industry Works
City: Zgierz
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
1,793	0	1,793	27,500	< 1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Non-mineral salts	-	150 tons/yr	-	-

Company Profile

"BORUTA" is the largest manufacturer of dyestuff in Poland and employs about 1,800 people. The company produces over 200 dyes and intermediates for captive use and sales. Established in 1894, the company was privatized in 1993. "BORUTA" has a long history of environmental improvements. Between 1988 and 1993, emissions were reduced by 94 percent, to 25 tons/year. Wastewater discharges were reduced by 50 percent, to 2,200 tons per year.

Waste Minimization Project

At "BORUTA", sodium sulfate is being recovered from wastewater for reuse at the plant. Effective operation of the sodium sulfate recovery process depends on reliable wastewater analyses. These analyses must provide operators with timely and accurate information on chemical oxygen demand (COD) levels to determine if the wastewater requires treatment with activated carbon. In the past, wastewater analyses were done infrequently and were inaccurate.

During the waste minimization project, a study was conducted to improve the sodium sulfate recovery process. The optimum process conditions were defined and it was concluded that sodium sulfate recovery could be significantly improved by implementation of a fast and reliable method for the determination of COD in the wastewater.

In order to improve the COD analytical capability, a spectrophotometer was purchased and installed. This instrument provides fast and reliable COD analyses. This information allows operating personnel to adjust process conditions to maximize sodium sulfate recovery from wastewater. As a result of the waste minimization project, the facility reduced the amount of non-mineral salts in its wastewater discharges by 150 tons/year.

Equipment: Spectrophotometer DR2000; Supplier - HACH Company, Loveland, CO
Cost - $1,793 (by USAID)
Note: The actual equipment cost was $5,380. Since the equipment has been utilized in two other waste minimization projects, only one-third of the cost is assigned to this project.

Completion Date: July 1995

Better Process Control at Wastewater Treatment Plant Increases Waste Recycling and Reduces Wastewater

Company: "BORUTA" S.A. Dyestuff Industry Works
City: Zgierz
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
1,794	0	1,794	31,200	3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	40 tons O_2/yr	-	-

Company Profile

"BORUTA" is the largest manufacturer of dyestuff in Poland and employs about 1,800 people. The company produces over 200 dyes and intermediates for captive use and sales. Established in 1894, the company was privatized in 1993. "BORUTA" has a long history of environmental improvements. Between 1988 and 1993, emissions were reduced by 94 percent, to 25 tons/year. Wastewater discharges were reduced by 50 percent, to 2,200 tons per year.

Waste Minimization Project

In the production of sulfur dyes, "BORUTA" uses organic wastes as a raw material. These organic wastes are generated by air oxidation of process wastewaters. In the past, this process did not operate under optimum conditions resulting in excessive discharges of organic wastes.

During the waste minimization project, methods for improving the organic waste recovery yield and decreasing the amount of wastes discharged were evaluated. The optimum process conditions were defined and a conclusion was reached that a fast and reliable method for the determination of the chemical oxygen demand (COD) in the wastewater was needed to optimize the process. The existing approach for measuring COD based on grab samples was slow and unreliable.

In order to improve the COD analytical capability, a spectrophotometer was purchased and installed. This instrument provides frequent and reliable COD analyses which are completed in a substantially shorter period of time. This information allows process operators to adjust process conditions and run the oxidation process at the optimum level. As a result of the waste minimization project, the facility reduced its COD discharges by 40 tons O_2/year

Equipment: Spectrophotometer DR2000; Supplier - HACH Company, Loveland, CO
Cost - $1,794 (by USAID)
Note: The actual equipment cost was $5,380. Since the equipment has been utilized in two other waste minimization projects, only one-third of the cost is assigned to this project.

Completion Date: June 1995

Raw Material Substitution at Sodium Bisulfite Plant Saves Raw Materials and Reduces Wastewater

Company: "BORUTA" S.A. Dyestuff Industry Works
City: Zgierz
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
1,833	0	1,833	31,800	3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Non-organic salts	-	10 tons/yr	-	-
Sulfur dioxide	-	-	-	Yes

Company Profile

"BORUTA" is the largest manufacturer of dyestuff in Poland and employs about 1,800 people. The company produces over 200 dyes and intermediates for captive use and sales. Established in 1894, the company was privatized in 1993. "BORUTA" has a long history of environmental improvements. Between 1988 and 1993, emissions were reduced by 94 percent, to 25 tons/year. Wastewater discharges were reduced by 50 percent, to 2,200 tons per year.

Waste Minimization Project

One of the products manufactured at "BORUTA" is sodium bisulfite. In the production process, a specially prepared sulfur dioxide (SO_2) solution was used as a raw material. During the waste minimization project, the possibility of using an available post-absorption SO_2 solution was examined and found to be feasible. However, a fast and reliable analytical procedure was needed for the determination of sulfites and sulfates in the post-absorption solution before it could be used as a raw material in the production of sodium bisulfite.

In order to enable use of the post-absorption SO_2 solution, a special test kit was purchased and is currently being used with a HACH DR2000 spectrophotometer to provide quick analysis of sulfates and sulfites in the post-absorption solution. As a result, necessary analytical information is available to operating personnel to permit the use of the post-absorption SO_2 solution as a raw material in the bisulfite production process.

The waste minimization project resulted in raw material savings, lower operating costs, and reductions in the amount of inorganic salts discharged in wastewater.

Equipment:

Reagent set HACH 22723-00; Supplier - HACH Company, Loveland, CO
Cost - $40 (by USAID)
Spectrophotometer DR2000; Supplier - HACH Company, Loveland, CO
Cost - $1,793 (by USAID)
Note: The actual equipment cost was $5,380. Since the equipment has been utilized in two other waste minimization projects, only one-third of the cost is assigned to this project.

Completion Date: July 1995

Process and Equipment Modifications at Polyvinyl Chloride Plant Improve Yield and Reduce Air Emissions

Company: Chemical Works Oswiecim
City: Oswiecim
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	31,400	31,400	2,100,000	< 1 week

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Vinyl chloride	54 tons/yr	-	-	54 tons/yr

Company Profile

Chemical Works Oswiecim is one of the largest chemical companies in Poland. Construction of the plant began in 1945. Current employment is 6,000 people. Major products are rubbers and lattices (styrene-butadiene, nitrile-butadiene and others), monomers and vinyl plastics, styrene and styrene plastics, chlorinated solvents, chloroparaffins, esters, alkylbenzene, detergents, and others. These products are used domestically and exported to Austria, Germany, Sweden, and other countries.

Waste Minimization Project

At the polyvinyl chloride (PVC) production plant at Chemical Works Oswiecim, vinyl chloride monomer (VCM) is polymerized into "latex" containing 45 to 50 percent PVC in a water suspension and some unreacted VCM. Latex from the reactor is decompressed, heated with steam and degassed in a degassing system. The degassed latex is spray dried in a hot air stream. In the past, the air leaving the dryer contained excessive amounts of VCM, i.e., 3.0 kg VCM/ton of PVC. As a result, significant amounts of raw material VCM were released to the atmosphere. Because of the volumes discharged and the toxic nature of VCM, the plant had to pay substantial environmental fees and penalties.

During the waste minimization project, a detailed process reevaluation was conducted to find a more efficient method of latex degassing. It was determined that a new cascade degassing system with interstage latex heating by steam would improve the efficiency of the latex degassing process and reduce the content of VCM in the exhausted air by 90 percent, to below 0.3 kg/ton of PVC.

As a result of the project, the facility reduced its emissions of VCM by 54 tons/year and is now meeting allowable emission standards. The project reduced significantly the amount of environmental fees paid by the plant and liability posed by discharges of toxic materials to the environment.

Equipment: Equipment modification, piping, valves
Cost - $31,400 (by Chemical Works Oswiecim)

Completion Date: September 1993

Better Process Control at Polyvinyl Chloride Plant Reduces Air Emissions

Company: Chemical Works Oswiecim
City: Oswiecim
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
9,700	0	9,700	34,800	< 4 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Vinyl chloride	Yes	-	-	Yes

Company Profile

Chemical Works Oswiecim is one of the largest chemical companies in Poland. Construction of the plant began in 1945. Current employment is 6,000 people. Major products are rubbers and lattices (styrene-butadiene, nitrile-butadiene and others), monomers and vinyl plastics, styrene and styrene plastics, chlorinated solvents, chloroparaffins, esters, alkylbenzene, detergents, and others. These products are used domestically and exported to Austria, Germany, Sweden, and other countries.

Waste Minimization Project

At the polyvinyl chloride (PVC) production plant at Chemical Works Oswiecim, the vinyl chloride monomer (VCM) reaction was previously controlled by measuring the density of "latex" (polymerization product) samples periodically taken from the reactor. This procedure had many drawbacks. First, the density of latex samples was measured under conditions which were different than those in the reactor. Second, latex samples contained unreacted VCM which expanded under atmospheric pressure resulting in lower density measurements. Third, the sampling procedure (6 times/day from the reactor) was not safe and resulted in releases of VCM, a toxic and explosive material.

During the waste minimization project, it was concluded that the problems associated with latex density measurements could be eliminated by the installation of a nuclear density gauge inside the reactor. Installation of this gauge provides continuous measurement of latex density. As a result of this project, PVC product yield and quality has improved, emissions of VCM have decreased, and worker safety has improved.

Equipment: S-series nuclear density gauge; Supplier - TN Technologies, Round Rock, TX
Cost - $9,700 (by USAID)

Completion Date: March 1995

Raw Material Substitution At Vegetable Oil Plant Decreases Wastewater Discharges

Company: "BORYSZEW" S.A. Chemical and Plastics
City: Sochaszew
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	8,600	8,600	165,000	< 1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	67 tons O_2/yr	-	-
Biological oxygen demand	-	49 tons O_2/yr	-	-
Acetic acid	-	100 %	-	Yes

Company Profile

"BORYSZEW" S.A. Chemical and Plastics Company in Sochaszew specializes in the manufacture of auxiliary agents for the production and processing of plastics, products from polyvinyl chloride and high and low density polypropylene, anti-freezing fluids, polyvinyl acetate and glues for various uses, and pyrotechnic products. The company employs about 700 people and sells its products to both domestic and foreign markets. "BORYSZEW" was privatized in 1992.

Waste Minimization Project

"BORYSZEW" operates a vegetable oil production plant. In the past, acetic acid was one of the raw materials used during the epoxidation reaction in the vegetable oil production process. The wastewater from the process contained 15 to 18 percent acetic acid which is extremely difficult to biodegrade. As a result, the facility was discharging excessive volumes of contaminated wastewater into the river. The process also created explosion hazards in the vegetable oil production plant.

During the waste minimization project, efforts were directed toward finding a substitute for acetic acid that could serve as the oxygen carrier for the process. Several months of research and production trials resulted in identification of formic acid as a suitable substitute for acetic acid. Unlike acetic acid, formic acid decomposes easily by heating.

The raw material substitution did not require new equipment and the only costs incurred were those associated with the required research and production trials. The new process is more efficient, saves raw materials, and improves the quality of wastewater discharged into the river.

Equipment: None required

Completion Date: March 1995

Process Modification and Improved Process Controls at Dibutyl Maleate Plant Reduce Wastewater Discharges

Company: "BORYSZEW" S.A. Chemical and Plastics
City: Sochaszew
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
15,600	4,400	20,000	48,100	5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chemical oxygen demand	-	5.5 tons O_2/yr	-	-
Biological oxygen demand	-	5.5 tons O_2/yr	-	-
Steam and electricity	-	-	-	Yes

Company Profile

"BORYSZEW" S.A. Chemical and Plastics Company in Sochaszew specializes in the manufacture of auxiliary agents for the production and processing of plastics, products from polyvinyl chloride and high and low density polypropylene, anti-freezing fluids, polyvinyl acetate and glues for various uses, and pyrotechnic products. The company employs about 700 people and sells its products to both domestic and foreign markets. "BORYSZEW" was privatized in 1992.

Waste Minimization Project

The production of dibutyl maleate at "BORYSZEW" is a complicated process which involves an estrification reaction and a distillation operation. In the estrification reaction, maleic anhydride is reacted with butanol to form dibutyl maleate which is purified in a bubble-cap plate distillation column in a counter-current flow with super heated steam. The distillation is carried out under vacuum and volatile substances of water and n-butanol are evaporated during this operation. In the past, process yields in the dibutyl maleate plant were unsatisfactory and resulted in excessive hazardous waste generation which was discharged into the wastewater treatment plant.

During the waste minimization project, research and production trials were conducted to identify methods for improving product yield and decreasing waste generation. As a result, several process changes were implemented resulting in environmental and economic benefits. First, a decrease in the admissible acid number value during estrification reduced waste generation. Second, replacement of superheated steam with compressed air improved the distillation efficiency and saved steam and electric energy. Finally, the purchase and use of an automatic flash point analyzer improved product yields and reduced waste.

Equipment: Herzog automatic flash point analyzer; Supplier - Vaslen Instruments, N.A., Joliet, IL;
Cost - equipment: $15,600 (by USAID), production trials: $4,400 (by BORYSZEW")

Completion Date: May 1995

Better Process Control at Animal Feed Production Plant Saves Raw Materials and Decreases Air Emissions

Company: Inorganic Works "Bonarka" **City:** Krakow
Industry: Chemical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
9,600	0	9,600	247,000	< 1 month

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Animal feed product	48 tons/yr	-	-	-
Miscellaneous emissions	960 tons/yr	-	-	-
Phosphoric acid	-	-	-	732 tons/yr
Dolomite	-	-	-	132 tons/yr
Calcium hydroxide	-	-	-	180 tons/yr

Company Profile

Bonarka operates an animal feed production plant in Krakow. The company is the sole producer in Poland of dicalcium fodder phosphate, a granular phosphorous-based animal feed. Two years ago, Bonarka changed its animal feed production process from a thermal reaction process to a wet phosphoric acid reaction process followed by drying.

Waste Minimization Project

Phosphorus content is the essential parameter influencing the quality of dicalcium fodder phosphate produced at Bonarka. Phosphoric acid, a raw material in Bonarka's production process, is the carrier of phosphorous. In the past, the manufacturing process was controlled by analysis of phosphorous content in the final product However, the determination of the phosphorous content in the product required eight hours from the time that sample was taken to completion of the laboratory analysis. This procedure allowed process adjustments based on phosphorous content measurements to be made only once every eight hours. Consequently, to obtain the required product quality, the facility typically used an excess of phosphoric acid in the amount of 40 to 80 kg/ton of product. This resulted in inefficient phosphoric acid use and in higher consumption of other raw materials such as dolomite and calcium hydroxide. In addition, this practice led to excessive product losses and generation of waste gases and dust.

During the waste minimization project, a spectrophotometer was purchased and installed. The new monitoring equipment is capable of completing analysis of phosphorous content within two hours. This allows operators to make process control adjustments four times per eight hour shift.

As a result of the project, the annual consumption of the following raw materials was significantly decreased: phosphoric acid by 732 tons/year; dolomite by 132 tons/year; and calcium hydroxide by 180 tons/year.

Equipment: DR UV-VIS Spectrophotometer with Accessories; Supplier - HACH Company, Loveland, CO
Cost - $9,600 (by USAID)

Completion Date: August 1995

Better Process Control at Solvent Recovery Plant Increases Waste Recycling and Reduces Air Emissions

Company: "VISCOPLAST" S.A.
City: Wroclaw
Industry: Chemical
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
10,600	7,900	18,500	19,360	< 12 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Naphtha	88 tons/yr	-	-	88 tons/yr
Steam	-		-	Yes

Company Profile

"VISCOPLAST" S.A., established in 1924, is one of the largest manufacturers of health care products in Poland. Products include medical plasters, technical tapes, technical glues, and polypropylene fibers. In 1981, a medical adhesive bandage department was added. In 1991, in cooperation with a Swedish partner company, a diaper manufacturing plant was opened. The company is constantly restructuring its production profile and technologies, and protection of the environment is one of the guiding factors. "VISCOPLAST" exports its products to the Baltic States and Russia. The plant employed 750 people in 1994.

Waste Minimization Project

In the production of medical plasters and technical tapes, acrylic and rubber glues dissolved in naphtha solvent are used. In order to recover and reuse the solvents and to avoid costly pollution problems, the facility has installed an activated carbon recovery system. It operates by first adsorbing solvent vapors onto fixed beds of granular activated carbon followed by desorption of the carbon beds with steam. In the past, the system performed poorly resulting in substantial naphtha losses and excessive steam use. Concentrations of naphtha in air and steam were determined from infrequent grab samples and were not sufficiently accurate.

During the waste minimization project, methods were evaluated for improving the overall efficiency of the solvent recovery process. It was concluded that continuous monitoring of naphtha and steam during the adsorption and desorption cycles would allow operators to adjust the cycle times and process parameters for optimum solvent recovery and steam use. Continuous monitoring of solvent concentrations in air and steam allows the operator to stop the desorption cycle at the appropriate time, thereby avoiding unnecessary steam usage. A shorter desorption cycle also provides additional time for the carbon bed to dry and to cool to below 32°C, which will ensure the best performance during the next adsorption cycle. To implement the project, a continuous hydrocarbon analyzer was purchased and installed. Installation of this continuous monitor has increased the efficiency of the solvent recovery system by 20 percent. Additional benefits of continuous monitoring include timely detection of leaks or excessive air infiltration into the system.

Equipment: Total Hydrocarbon Analyzer, Model 51-HT with Flame Detector and Multipoint Sampling; Supplier - Thermo Environmental Instruments Inc., Franklin, MA
Cost - equipment: $10,600 (by USAID), $6,000 (by "Viscoplast"), labor and parts: $1,900 (by "Viscoplast")

Completion Date: July 1995

Change in Operating Procedures at Butyl Acetate Regeneration Plant Saves Raw Materials

Company: Pharmaceutical Works "POLFA"
City: Tarchomin
Industry: Pharmaceutical
Country: Poland

Economic Benefits

Investment ($)			Savings	Payback
USAID	Company	Total	($/Year)	Period
0	100	100	12,000	< 1 week

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Steam	-	-	-	Yes
Fresh water	-	-	-	Yes
Energy	-	-	-	3 %
Caustic	-	120 tons/yr	-	120 tons/yr

Company Profile

The Tarchomin Pharmaceutical Works "POLFA" was founded in 1823. Employing about 2,800 people, the company is currently the largest pharmaceutical manufacturer in Poland with product sales both to domestic and foreign markets. The company's production capability is measured in thousands of tons and millions of pharmaceutical dosage units of different drug forms per year. The main product groups are: antibiotics, insulin, and psychotropic drugs.

Waste Minimization Project

"POLFA" operates a butyl acetate regeneration process. The regeneration of butyl acetate is based on distillation of post-extraction water containing up to 3 percent of butyl acetate. The raw product contains some protein components which tend to agglomerate and block metal surfaces. This problem was particularly troublesome in the plate heat exchanger used to heat the raw butyl acetate. To alleviate this problem in the past, the process was frequently interrupted to permit washing of equipment with a 40 percent caustic soda solution. Consumption of caustic was about 0.15 kg/kg of regenerated butyl acetate. Caustic washing discharges to the central wastewater treatment plant resulted in disruption in treatment plant operations.

During the waste minimization project, methods were evaluated for reducing the consumption of caustic soda and improving production flow. A decision was made to change the operating procedures during the washing operations to enable washing without process shut-down. Implementation of the project required minor piping modifications. In addition, a small amount of caustic is now continuously added to the raw material preceding the plate exchanger. This procedure prevents clogging of the plate exchanger and other equipment. As a result of the project, the caustic consumption has decreased to 0.03 kg/kg of butyl acetate. Other benefits are decreased caustic consumption and steam consumption for washings and improved process efficiency.

Equipment: Piping, pump (available at plant)
Cost - $100 (by POLFA)

Completion Date: June 1994

Equipment Modifications and Repairs at Ryfamycin Plant Improve Process Efficiency and Reduce Releases

Company: Pharmaceutical Works "POLFA"
Industry: Pharmaceutical
City: Tarchomin
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
0	51,000	51,000	198,000	< 4 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Chloroform	65 tons/yr	-	-	-
Tetrabutylamine	3.6 tons/yr	-	-	-
Ethyl acetate	116 tons/yr	-	-	-
Isopropanol	17.3 tons/yr	-	-	-
Tetrahydrofuran	25.2 tons/yr	-	-	-
Acetone	21 tons/yr	-	-	-
Wastewater	-	23,800 m^3/yr	-	-
Fresh water	-	-	-	23,800 m^3/yr

Company Profile

The Tarchomin Pharmaceutical Works "POLFA" was founded in 1823. Employing about 2,800 people, the company is currently the largest pharmaceutical manufacturer in Poland with product sales both to domestic and foreign markets. The company's production capability is measured in thousands of tons and millions of pharmaceutical dosage units of different drug forms per year. The main product groups are: antibiotics, insulin, and psychotropic drugs.

Waste Minimization Project

One of the many products manufactured at "POLFA" is Ryfamycin. The production of Ryfamycin involves multiple process operations, including extraction, hydrolysis, cooling, vacuum distillation, washing, drying, crystallization, and condensation. During many of these operations, solvent losses to the environment occurred through leaks in piping and equipment. This resulted in inefficient process operations, health risks to workers and nearby residents from exposure to toxic pollutants and other environmental problems.

During the waste minimization project, a thorough evaluation of the Ryfamycin plant was conducted. The results showed that equipment modifications in selected operations and detection and repair of leaks in piping and other equipment would improve process efficiencies and reduce health risks and other environmental problems. The following improvements resulted from the project. First, modification of the cooling systems used in vacuum distillation operations decreased solvent losses and improved process control. Second, replacement of a vacuum system with a pumping system for solvent transfer decreased solvent losses. Third, optimization of vacuum pump operations decreased water consumption and wastewater discharges. Finally, detection and repair of leaks using a portable organic gas analyzer significantly decreased solvent losses. (Note: The analyzer was purchased to detect leaks in the entire plant.)

Equipment: Modified cooling systems; new pumping system; modified vacuum pumps
Cost - $51,000 (by "POLFA")

Completion Date: June 1995

Detection and Repair of Equipment Leaks at Pharmaceutical Plant Reduces Air Emissions

Company: Pharmaceutical Works "POLFA" **City:** Tarchomin
Industry: Pharmaceutical **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
4,500	5,500	10,000	88,000	< 2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Solvents	135 tons/yr	-	-	135 tons/yr

Company Profile

The Tarchomin Pharmaceutical Works "POLFA" was founded in 1823. Employing about 2,800 people, the company is currently the largest pharmaceutical manufacturer in Poland with product sales both to domestic and foreign markets. The company's production capability is measured in thousands of tons and millions of pharmaceutical dosage units of different drug forms per year. The main product groups are: antibiotics, insulin, and psychotropic drugs.

Waste Minimization Project

"POLFA" uses many organic solvents in various production processes. Material balances indicated substantial solvent losses were occurring due to fugitive emissions from equipment and piping leaks. Without proper leak detection equipment it was impossible to detect and repair the many solvent leaks throughout the plant from flanges, valves, servicing hatches, etc.

During the waste minimization project, an investigation was undertaken to find a cost-effective procedure to minimize or completely eliminate the solvent losses. WEC experts developed a plant-wide Leak Detection and Repair Program (LDARP) based on U.S. experience. A Bacharach portable organic gas analyzer was purchased to implement the program.

This program was successfully tested at the Ryfamycin process at "POLFA" in June 1995 and is now being used throughout the plant. The program is projected to detect and eliminate a minimum of 300 leaks per year which will result in reductions in solvent losses of 135 tons/year. The savings realized from decreased solvent losses and environmental fees will significantly outweigh the costs associated with leak detection and repair.

Equipment: Bacharach TLV Sniffer 23-7356; Supplier - Bacharach, Pittsburgh, PA
Cost - $4,500 (by USAID)

Completion Date: August 1995

Better Process Control at Zinc Melting Furnace Improves Process Efficiency and Decreases Waste

Company: Metallurgical Works "SILESIA" **City:** Katowice
Industry: Non-Ferrous Metals **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
24,380	2,120	26,500	77,500	< 5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Particulates (containing zinc)	30 tons/yr	-	-	-
Solid waste (containing zinc)	-	-	160 tons/yr	-
Natural gas	-	-	-	50,000 m^3/yr

Company Profile

Founded in 1849, "SILESIA" is one of the oldest zinc manufacturers in Europe. In 1980, the plant underwent a major environmental restructurization and the raw ore processing department was closed. Currently in operation are the pure zinc rectification units, rolling mill, wire-drawing unit, zinc recovery furnace from dross and scrap, and zinc dust production facility. Products manufactured at the plant include: rectified zinc - 99.99 percent, zinc powder, zinc dust, cadmium, zinc sheets, flats, anodes, wire, and roll formed products. The company exports products to Germany, France, and Czech Republic. The number of employees is 650.

Waste Minimization Project

At "SILESIA," the zinc rectification line consists of two melting furnaces, two lead rectifying columns, a cadmium rectifying column and two refining furnaces. Impure slab zinc and secondary zinc (zinc plates 97.5 - 98.7 percent Zn, Thede secondary zinc) are melted in a natural gas heated furnace at 500 to 600 °C and continuously poured into the lead column. The majority of solid waste (dross) is generated in the melting process. Melted zinc is oxidized by the oxygen present in the flue gas and oxygen drawn in from the atmosphere in trough chamber leakages and furnace doors. Large amounts of zinc oxide fumes and dust are generated when dross is skimmed from melting furnaces. In the past, up to 160 tons of solid waste and 30 tons of dust were generated annually.

During the waste minimization project, a process optimization program was undertaken to improve product yield, decrease waste generation and improve the combustion process in furnaces. It was determined that the primary obstacle for process optimization was the inability to adjust burner air and fuel settings for optimal combustion without on-line combustion analysis and flow and combustion pressure measurement devices. In order to optimize the melting process and gas combustion in the melting furnaces, two oxygen/carbon monoxide analyzers with display modules and controllers were purchased and installed. This system allows for on-line process control and operation of the furnaces at optimum levels. As a result of the waste minimization project, "SILESIA" increased its furnace production by 10,220 tons/year, while reducing its natural gas consumption by 50,000 m^3/year and emissions by 10 percent.

Equipment: Oxygen/CO analyzer Model WDG-HPIIC with series 2000 controller, calibration and control units; Supplier - Ametec, Incorporated, Pittsburgh, PA; Cost - equipment: $24,380 (by USAID), labor: $2,120 (by "SILESIA")

Completion Date: August 1995

Better Process Control at Metal Leaching Operation Improves Process Efficiency and Decreases Waste

Company: Mining and Metallurgy Enterprise "BOLESLAW" **City:** Bukowno
Industry: Non-Ferrous Metals **Country:** Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
15,000	12,000	27,000	204,030	< 2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Waste electrolytes	-	7,500 m^3/yr	-	-
Zinc sludge	-	-	1,000 tons/yr	-
Miscellaneous emissions	360 tons/yr	-	-	-
Energy	-	-	-	20 kWh[(a)]

[(a)] per ton of product

Company Profile

Mining and Metallurgy Enterprise "BOLESLAW," whose mining and metallurgical traditions date back to the 13th century, is one of the oldest industrial complexes in Poland. The enterprise is currently the leading zinc producer and exporter in Poland. The company produces electrolytic zinc, lead concentrate, raw zinc oxide, lead-zinc oxide, zinc sulfate, zinc cast alloy, zinc concentrates, sintered zinc oxide, cadmium sponge, and sulfuric acid.

Waste Minimization Project

In the metal leaching operation at "BOLESLAW," process effectiveness depends on maintaining proper pH levels. In the past, pH was measured using paper indicators (litmus papers) and results were not readily available (up to 1 hour delay for sedimentation tanks). As a result, the leaching plant did not operate under optimum conditions, resulting in excessive zinc dust use and high waste electrolyte and sludge generation.

During the waste minimization project, a leaching process optimization program was undertaken to improve product yield, decrease raw material use and generation of wastes. The optimum process conditions were defined and a decision was made to install a specially designed on-line pH control system. A U.S.-manufactured pH control system was purchased and installed. This instrumentation allows operators to adjust process conditions and run the leaching plant at optimum conditions. As a result of the waste minimization project, "BOLESLAW" experienced leaching yield improvements of 0.2 percent, zinc dust consumption decreases of 1.5 kg/ton of product, and energy consumption reductions of 20 kWh/ton of product.

Equipment:

2 pH analyzers, model 873DPX-BIYFNZ7; Supplier - Foxboro Inc., Plano, TX;
Cost - $9,600 (by USAID)
2 pH analyzers, model 54 pH/ORP-05-07; Supplier - Rosemont Inc., Dallas, TX;
Cost - $5,400 (by USAID)
Flow meter, 2 electric motor regulators; Supplier - Local;
Cost - $12,000 (by "BOLESLAW")

Completion Date: July 1995

Better Process Control at Copper Plant Improves Process Efficiency and Decreases Waste

Company: HUTMEN S.A.
Industry: Non-Ferrous Metals
City: Wroclaw
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
12,600	2,200	14,800	243,700	3 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Particulates (lead, zinc, cadmium and others)	2.2 tons/yr	-	-	-
Carbon monoxide	400 tons/yr	-	-	-
Coke	-	-	-	10 %

Company Profile

HUTMEN S.A. is a large non-ferrous metals company founded in 1945, producing drawn and extruded products of copper, brass and bronze in the form of rods, tubes, wires, and sections, as well as metallurgical products such as shaft copper, cast bronzes and brasses, lead alloys, and tin-lead solders. About 40 percent of products are exported, primarily to the U.S., Germany, and South-East Asia. In 1994, the company employed 1,300 people.

Waste Minimization Project

At HUTMEN, copper containing zinc, lead and tin is produced in a shaft furnace. The furnace charge consists of different metallurgical wastes such as skimmings, ash, skulls, and slags, with granulation within the range from 0.5 to 500 mm. Copper content in these materials ranges from 20 to 60 percent. In addition, 2 to 6 percent of fluxes, such as SiO_2, $CaCO_3$, iron, and ferrosilica are used in the process. In the past, the shaft furnace did not operate under optimum conditions resulting in excessive volumes of dust, CO emissions and product losses.

During the waste minimization project, a process optimization program was undertaken to improve product yield and ease waste generation. The optimum process conditions were defined and a conclusion was reached that in order to adjust the shaft furnace process to these conditions, it is necessary to maintain liquid metal and slag at optimum temperatures and to run the process in a reducing atmosphere with minimum excess of CO. To implement the project, equipment for continuous measurement and control of CO concentration in the shaft furnace and for liquid metal temperature control was purchased and installed. This instrumentation now allows operators to adjust process conditions and run the furnace at optimum conditions.

As a result of the waste minimization project, "HUTMEN" experienced the following benefits: product yield improvement of 0.3 percent; coke consumption reduction of 10 percent; increased furnace output by 15 percent; dust emissions reduction by 15 percent; and CO emissions reduction by 20 percent.

Equipment: CO Analyzer; Supplier - Nova Analytical Systems, Inc., Niagara Falls, NY; Cost - $9,000 (by USAID), labor - $2,200 (by HUTMEN)
Infrared Thermometer; Supplier - OMEGA Engineering, Inc., Stanford, CT; Cost - $3,600 (by USAID)

Completion Date: August 1995

Equipment Modification at Meat Plant Saves Water and Reduces Wastewater Discharges

Company: "AGRYF" Meat Plant
Industry: Food
City: Szczecin
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
10,000	3,000	13,000	80,000	< 2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-		140,000 m^3/yr
Wastewater	-	140,000 m^3/yr	-	-

Company Profile

The "AGRYF" Meat Plant in Szczecin was built between 1983 and 1986 and placed into service in 1986. The company has both cattle and pig slaughtering operations. Production operations include boning, sausage production, meat processing, ham production and canning, and edible byproducts processing. Production capacity includes: slaughter - 58,000 tons/year; partition of carcasses - 31,700 tons/year; sausages - 1,500 tons/year; and canned products - 3,400 tons/year.

Waste Minimization Project

In the past, wastewater flows and pollutant loadings at "AGRYF" were considerably higher than at similar facilities in the U.S. All cleaning operations were performed using open ended rubber hoses. Operators used fingers at the discharge end of hoses to manually develop a spray for cleaning. In addition, hoses were not equipped with shut-off nozzles to prevent water flow if left unattended. Similarly, spray systems at the facility were not configured properly and were not equipped with spray nozzles. Finally, dry cleanup prior to the start of sanitation hosing was inadequate.

During the waste minimization project, methods were investigated for reducing water use and waste generation. To implement the project, a new dry cleanup procedure was introduced, open ended rubber hoses were equipped with shutoff spray nozzles, and spray systems were equipped with proper nozzles. As a result of the project, the plant achieved a 50 percent reduction in water use and reduced its wastewater discharges by the same amount.

Equipment:
Spray nozzles, spray guns; Supplier - Spraying Systems Company, Wheaton, IL
Cost - $10,000 (by USAID)
Piping valves; Supplier - local
Cost - equipment and labor: $3,000 (by "AGRYF")

Completion Date: August 1995

Equipment Modification at Meat Plant Saves Water and Reduces Wastewater Discharges

Company: "LMEAT" Meat Plant
Industry: Food
City: Lukow
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
9,900	4,800	14,700	160,000	5 weeks

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	185,000 m^3/yr
Wastewater	-	185,000 m^3/yr	-	-

Company Profile

"LMEAT" Meat Plant in Lukow was established in 1973. Annual production capacity is 50,000 tons of meat products based on an annual slaughter of 80,000 tons. Approximately 25 percent of "LMEAT's" production is sold through 33 factory stores. The company also exports canned meat products to Germany, Austria, Sweden, and the U.S. In 1994, "LMEAT" employed 2,000 people.

Waste Minimization Project

In the past, wastewater flows and pollutant loadings at "LMEAT" were generally two to three times higher than at similar facilities in the U.S. All cleaning operations were performed using open ended rubber hoses. Operators used fingers at the discharge end of hoses to manually develop a spray for cleaning. In addition, hoses were not equipped with shut-off nozzles to prevent water flow if left unattended. Similarly, spray systems at the facility were not configured properly and were not equipped with spray nozzles. Finally, dry cleanup prior to the start of sanitation hosing was inadequate.

During the waste minimization project, methods were investigated for reducing water use and waste generation. To implement the project, a new dry cleanup procedure was introduced, open ended rubber hoses were equipped with shutoff spray nozzles and spray systems were equipped with proper nozzles. As a result of the project, the plant achieved a 58 percent reduction in water use and reduced its wastewater discharges by the same amount.

Equipment: Spray nozzles, spray guns, jet nozzles; Supplier - Spraying Systems Company, Wheaton, IL
Cost - equipment: $9,900 (by USAID), labor: $4,800 (by "LMEAT")

Completion Date: August 1995

Better Process Control at Dairy Plant Reduces Wastewater Discharges

Company: Garwolin Dairy
Industry: Dairy
City: Garwolin
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
2,590	0	2,590	3,480	9 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Biological oxygen demand	-	Yes	-	-

Company Profile

Garwolin Dairy, a cooperative of over 9,000 farmers, produces pressed cottage cheese and butter in addition to milk packaged in paper containers. Surplus milk and milk products that fail bacterial count are processed to manufacture casein. Casein is exported to Germany for use in the manufacture of certain types of plastic and glue. The dairy processes approximately 130,000 liters of milk per day.

Waste Minimization Project

The Garwolin Dairy recently constructed its own biological wastewater treatment plant. In the past, the performance of the wastewater treatment plant was determined by biological oxygen demand (BOD) levels in the treatment plant effluent. The BOD analyses required five days for incubation of the samples. Due to this delay, BOD measurements were not very useful for controlling performance of the treatment plant. Moreover, one full time technician was required to accomplish the BOD analyses.

During the waste minimization project, a Chemical Oxygen Demand (COD) analyzer was purchased and installed. The COD analyzer measures oxygen demand in the treatment plant effluent with a high degree of accuracy and provides results in less than 30 minutes. As a result of the project, the facility can maintain better control of its wastewater treatment plant performance. In addition, the facility has eliminated one laboratory technician position. Another benefit is availability of accurate, timely data for demonstrating compliance with regulatory requirements.

Equipment: DR 2000 Spectrophotometer; Supplier - Hach Company, Loveland, CO
Cost - $2,590 (by USAID)

Completion Date: March 1995

Equipment Modification at Dairy Plant Reduces Water Use and Wastewater Discharges

Company: Garwolin Dairy
Industry: Dairy
City: Garwolin
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
6,450	0	6,450	10,400	7.5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	30,000 m^3/yr
Wastewater	-	30,000 m^3/yr	-	-

Company Profile

Garwolin Dairy, a cooperative of over 9,000 farmers, produces pressed cottage cheese and butter in addition to milk packaged in paper containers. Surplus milk and milk products that fail bacterial count are processed to manufacture casein. Casein is exported to Germany for use in the manufacture of certain types of plastic and glue. The dairy processes approximately 130,000 liters of milk per day.

Waste Minimization Project

At Garwolin Dairy, milk and whey delivery trucks are washed every day with a combination of hot and cold water. Process equipment, storage tanks, and the process and milk delivery areas are also washed every shift with hot and cold water. In the past, all cleaning operations were performed using piped hot and cold water connected to open ended rubber hoses. Spray was created manually and was relatively inefficient for effective cleaning. Because the hoses were not equipped with shut-off nozzles, the water was often left running for extended periods until the operators had time to shut off the needle valves located on the walls.

During the waste minimization project, efforts focused on reducing wastewater. High pressure washers connected directly to water supply lines were purchased for cleaning of trucks, production areas, and equipment. In addition, open ended rubber hoses were equipped with shutoff spray nozzles. As a result of the project, consumption of water was reduced from approximately 700 m^3/day to about 620 m^3/day, while improving the cleanliness of the equipment and production floor.

Equipment: Tuff-Cat Power washers; Supplier - Mobile Sales, Littleton, MA and Northern Equipment, Inc., Burnsville, MN
Strahman automatic water-saver spray nozzles; Supplier - Spraying Systems Company, Randolph, NJ
Total Cost - $6,450 (by USAID)

Completion Date: March 1995

Equipment Modification at Dairy Plant Saves Steam and Reduces Energy Use

Company: Zakopane Dairy
Industry: Dairy
City: Zakopane
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
2,200	0	2,200	15,600	< 2 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Steam	-	-	-	926 tons/yr

Company Profile

Zakopane Dairy is a regional dairy plant located in the Tatra mountainous region of Poland. In addition to pasteurized milk, the dairy produces cream, kefir, ice cream, swiss cheese, yogurt, guarag cheese, and pressed cottage cheese. Zakopane Dairy processes approximately 80,000 liters of milk per day.

Waste Minimization Project

Energy costs represent one of the single highest operating expenses at Zakopane Dairy. The plant operates two boilers, which together consume 3,000 liters/day of fuel oil. The boilers supply hot water and steam for milk processing and for cleaning of equipment and production areas. Since the steam use is periodic, unused steam is condensed and used to preheat feed water. In the past, steam traps were inadequate. As a result, some of the steam was not condensed and was lost to the atmosphere.

During the waste minimization project, it was determined that new steam traps would decrease steam losses. To implement the project, new steam traps were installed. As a result, the facility reduced its steam consumption by 926,000 kg/year and saved energy.

Equipment: Armstrong Float and Thermostatic Steam Traps; Supplier - Hughes Machinery Company, Overland Park, KS;
Cost - $2,200 (by USAID)

Completion Date: September 1995

Equipment Modification at Dairy Plant Reduces Water Use and Wastewater Discharges

Company: Zakopane Dairy
Industry: Dairy
City: Zakopane
Country: Poland

Economic Benefits

Investment ($)			Savings ($/Year)	Payback Period
USAID	Company	Total		
2,250	0	2,250	5,100	5 months

Environmental Benefits

Material	Reductions in Environmental Releases			Raw Material Savings
	Air	Water	Land	
Fresh water	-	-	-	6,420 m^3/yr
Wastewater	-	6,240 m^3/yr	-	-

Company Profile

Zakopane Dairy is a regional dairy plant located in the Tatra mountainous region of Poland. In addition to pasteurized milk, the dairy produces cream, kefir, ice cream, swiss cheese, yogurt, guarag cheese, and pressed cottage cheese. Zakopane Dairy processes approximately 80,000 liters of milk per day.

Waste Minimization Project

At Zakopane Dairy, milk and whey delivery trucks, process equipment, storage tanks, and the process and milk delivery areas are washed every shift with hot and cold water. In the past, all cleaning operations were performed using piped hot and cold water connected to open ended rubber hoses. Spray was created manually and was relatively inefficient for effective cleaning. Because the hoses were not equipped with shut-off nozzles, the water was often left running for extended periods until the operators had time to shut off the needle valves located on the walls.

During the waste minimization project, efforts focused on reducing wastewater. The dairy installed one high pressure washer in the truck unloading area connected directly to the water suply lines. In addition, open ended rubber hoses were equipped with shutoff spray nozzles. As a result of the project, the dairy reduced its water use by 12 percent while improving the cleanliness of the equipment and production floor.

Equipment: Tuff-Cat Power washers; Supplier - Mobile Sales, Littleton, MA;
Strahman automatic water-saver spray nozzles; Supplier - Spraying Systems Company, Randolph, NJ
Total Cost - $2,250 (by USAID)

Completion Date: March 1995

WEC Pollution Prevention Centers in Poland

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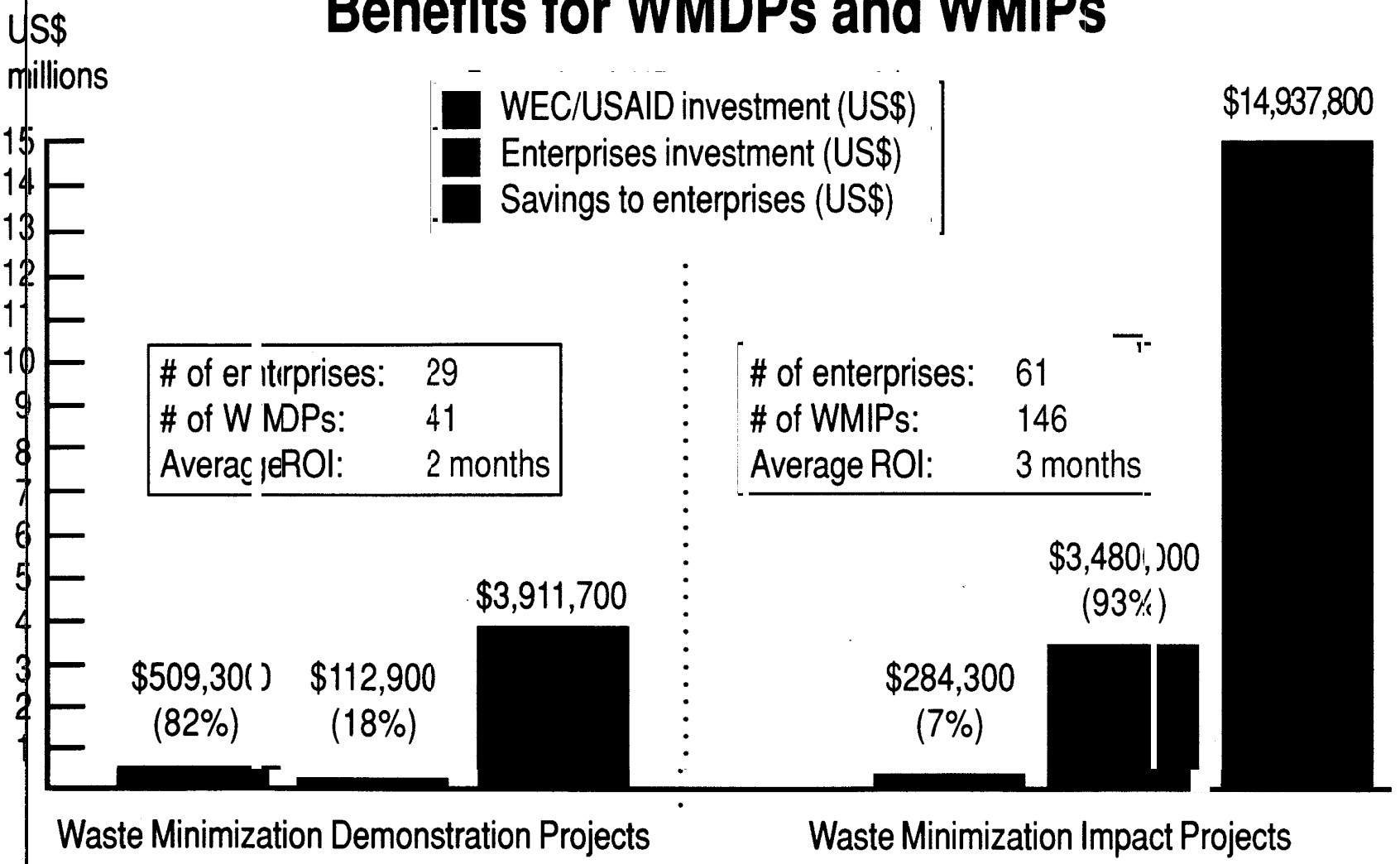
Comparison of Capital Investments and Economic Benefits for WMDPs and WMIPs



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