PD ABM-319

WORLD ENVIRONMENT CENTER

CZECH REPUBLIC

WASTE MINIMIZATION IMPACT PROGRAM PROGRESS EVALUATION VISITS TO PLANTS

June 17 - 24, 1995

Plants Visited:

Lachema
Farmakon
Moravske Chemicke Zavody
Ostramo

World Environment Center
419 Park Avenue South, Suite 1800
New York, New York 10016

OCTOBER 1995

REPORT DISTRIBUTION

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File

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INTRODUCTION

The World Environment Center (WEC) conducted a Waste Minimization Workshop in the Czech Republic during the period of May 16 - May 19, 1994. The Workshop introduced the concepts and practices of waste minimization to Czech industries. The participating companies were given assignments whereby they would implement actual waste minimization projects at their plants.

In order to evaluate the progress of the firms in carrying out the assignments given in the May Workshop, WEC followed up with a one-day Seminar on November 14, 1994. This Seminar also stressed the implementation of the Waste Minimization Program in the various plants and factories and reviewed each of the elements of the program that was discussed at the May Workshop. A model example was also presented that could be used directly, or with appropriate modifications, allowing a plant or factory to develop their own waste minimization program.

During the period June 17 through 24, 1995, a WEC team visited four companies in the Czech Republic to evaluate their progress in carrying out their waste minimization projects. The team consisted of a WEC Project Manager, Mr. Frank Szymborski, the WEC In-Country Coordinator for the Czech Republic, Mrs. Ludmila Hofmanova, a Volunteer Specialist, Mr. W. Brock Neely and a Pollution Prevention Center representative. The companies visited included: **Lachema, Farmakon, Moravske Chemicke Zavody** and **Ostramo** In particular, the WEC team was interested in how the plants implemented their commitments that included:

- The General Director was to issue a Waste Minimization Policy Statement;
- The plant was to establish a Waste Minimization Program, including the team structure, at all their facilities; and
- The plant was to identify and initiate the implementation of five small, short-term, no/low cost waste minimization projects.

EXECUTIVE SUMMARY BY PLANTS

LACHEMA

The firm has recently undergone a change in management, which could explain the delay in establishing WEC's Waste Minimization Program. A review of their proposed projects confirm that they are only in the planning stage. However, WEC's discussions with plant personnel illustrates an excellent example of waste minimization - obviously a direct result of involvement by the batch process crew. In the extraction of adamantone from the reactor mixture, the crew was able to identify a new extraction solvent, which not only reduces air emissions but also results in an annual savings of $5,000. Lachema is mainly concerned with the high discharge rate of carbon products going into the waste water system and then into the river. Their problem is very complex in that 300 different products are produced by batch procedures. COD monitoring equipment would be extremely useful to ascertain the main source of the organic pollutants.

FARMAKON

This firm has also been involved in a change in management, and like Lachema, WEC's Waste Minimization Program has not been implemented. Even though their proposed projects are only in the planning stage, they are definitely committed to WEC's waste minimization philosophy. One visit to their plant will confirm why they are extremely receptive to WEC's Waste Minimization Program. The plant is literally located in the center of a densely populated area, exposing their neighbors to noxious and toxic emissions. To illustrate their problem, all the locals refer to the plant as that "smelly place". In order to maintain a good rapport with their immediate neighbors, Farmakon has established a committee to monitor their efforts to achieve a pollution-free environment. This committee includes representatives from Government Environmental Agencies, Health Department, the media, as well as concerned citizens from the immediate neighborhood. In addition, they have initiated regular public meetings where Farmakon can keep all concerned individuals informed of the plant's progress in pollution abatement.

MORAVSKE CHEMICKE ZOVODY (MCHZ)

MCHZ is very much an environmental protection oriented firm and its management has committed itself to support WEC's Waste Minimization Program. They have now established waste minimization teams to set-up and coordinate the entire program. Total management involvement in the program can be attested to by their adoption of WEC's very basic philosophy - preventing a pollution problem at the source is preferable to solving the problem at the end of the pipe. In this regard, the plant, whenever possible, continues to revise both their technological and/or manufacturing processes to eliminate or at least

minimize any potential pollution impact on the environment. The WEC team reviewed MCHZ's projects which reflect their immediate Waste Minimization Program goals of reducing both NH_4^+ polluted waste water and solid wastes by at least 50%.

OSTRAMO

Management has a very clear understanding of WEC's Waste Minimization Program , and has identified their problem as well as the temporary and permanent solutions to their pollution. Due to their use of outdated technology for the treating and handling of used oil, the soil immediately under the plant is completely saturated with spent petroleum products. With the assistance of WEC and the EPA, they have proceeded in a logical sequence to initiate and implement an immediate/temporary solution while they take time to evaluate and analyze various alternatives for their permanent solution. To develop the project's required scope-of-work, complete with associated costs and savings, management has assembled a very competent staff to perform the waste minimization functions. All levels of management responsibility are involved, and the plant is to be commended for the excellent job completed by the various teams in identifying and quantifying all possible costs and savings. Under the direction and guidance of Ostramo's extremely dynamic owner/manager, there is no doubt that their soil contamination problem will be resolved once and for all.

Following Comment is Pertinent to All Plants

For maximum impact of WEC's Waste Minimization Brochure (printed in the language of the country), it was suggested that it be distributed together with a letter from the plant's General Manager committing the firm to WEC's program.

PLANT VISIT REPORTS

COMPANY:	**LACHEMA**	
Location:	Brno, Czech Republic	
Date of Visit:	June 19, 1995	
Company Representatives:	Josef Beran	Chief of Water Management Dept.
	Jiri Jelinek	Technician in Production Div.
	Ladislav Kadlec	Chief Technical Production Dept.
	Karel Knoflicek	Technician
	Jan Kos	Technology Manager
	Ruzena Krivonkova	Strategy and Marketing
	Richard Machat	General Director
	Rostislav Nebola	Strategy and Marketing
	Jaroslav Pecek	Chief of Environmental Dept.
WEC Team:	Frank Szymborski	Project Manager
	Ludmila Hofmanova	In-Country Coordinator
	Brock Neely	Volunteer Specialist
	Bohuslav Moucha	PPC Representative

COMPANY PROFILE: Lachema was established in Brno in 1951 for the manufacturing of fine laboratory and special chemicals. Since then it has expanded considerably and, in addition, has diversified its product line. Today, it is not only a chemical firm but also a well-known manufacturer of pharmaceuticals and diagnostic preparations. In 1991 Lachema was privatized as a joint-stock company with two subsidiaries located in Blansko and Nerayovice. In 1994 total sales were $43.0 million.

REVIEW OF PLANT'S THREE WMIP PROJECTS

PROJECT NO. 1

Problem Area: Urea peroxyhydrate is manufactured by adding a 35% solution of hydrogen peroxide to urea followed by product crystallization and separation. The mother liquors formed contain approximately 11% urea peroxyhydrate. The mother liquors are disposed of by discharging directly into the waste water system.

Solution: Plant proposes to increase hydrogen peroxide concentration from 35% to 50%. This would not only reduce the water infiltration in the reaction mixture but also lower the solubility of the product and increase the reaction yields from 60% to 90%.

Monetary Savings: Obtaining higher yields on a production rate of 50 tons/year of urea peroxyhydrate results in a **Savings of $19,000/year.**

Environmental Benefits: Decreased organic contamination in the waste water.

Project Completion Date: Unknown.

PROJECT NO. 2

Problem Area: Adamantane is extracted from the reaction mixture using an "extra-active" gasoline with a boiling point of 80^0-110^0C. During this stage of the process, some of the gasoline is trapped in the mother liquor which is disposed of by incineration. Additional gasoline is lost in the product separation and drying process because of the high volatility of the "extra-active" gasoline.

Solution: Two solutions are under consideration;
- Utilize a more suitable fraction of gasoline with a higher boiling point 90^0-160^0C and which does not contain unsaturated hydrocarbons and aromates.
- Utilize decaline, a by-product from the isomerization of trimethylene nobornane substitute for the "extra-active" gasoline.

Monetary Savings: Using either solution reduces solvent costs by 1/3 and, in addition, reduces the waste incineration costs for a total **Savings of $7,000/year.**

Environmental Benefits: Reduces waste solvents requiring incineration.

Project Completion Date: 1995.

PROJECT NO. 3

Problem Area: In the manufacturing process of glycerine esterification, using acetic anhydride, acetic acid is generated as a by-product. Most of the resulting acetic acid cannot be reused in esterification and the surplus acid is sold separately.

Solution: Plant proposes to use a procedure which utilizes a reduction mixture distilled from the previous batch. Then, distilling out the reaction water results in a partial glycerine esterification. With the addition of acetic anhydride, the esterification process is completed and results in a mixture with the required composition.

Monetary Savings: Plant can save approximately 60 tons/year of acetic anhydrine in producing 300 tons/year of esterols, for a **Savings of $500,000/year.**

Environmental Benefits: Reduction in the organic contamination of the waste water.

Project Completion Date: Unknown.

BUSINESS CARDS OF LACHEMA REPRESENTATIVES ATTENDING DISCUSSIONS WITH WEC TEAM

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WEC Team:	Frank Szymborski	Project Manager
	Ludmila Hofmanova	In-Country Coordinator
	Brock Neely	Volunteer Specialist
	Rudolf Korinek	PPC Representative

COMPANY PROFILE: Farmakon produces intermediate chemicals used in the manufacture of pharmaceutical and disinfectant products. The plant recently invested over $8.0 million in environmental capital projects and associated equipment. The firm has 560 employees and total annual sales of $24.0 million/year.

REVIEW OF PLANT'S FOUR WMIP PROJECTS

PROJECT NO.1

Problem Area: Hydroxycumarin production generates emissions of aspirin chloride, petroleum ethers, hydrogen chloride and sulphur dioxide. These noxious emissions are toxic and not only endanger the workers' health and safety but also the residents in the neighboring residential areas.

Solution: Modify existing production facilities and improve the manufacturing procedures to include the neutralization of mother liquors, thereby eliminating emissions of ethers, hydrogen chloride and sulphur dioxide.

Monetary Savings: Burning petroleum ethers reduces heating costs. However, because of reduced production requirements, savings are negligible.

Environmental Benefits: Reduction in noxius and toxic emissions.

Project Completion Date: March 1996.

PROJECT NO. 2

Problem Area: The production of chlorobenzoyl-benzoic acid generates hydrogen chloride gases which are then captured in an absorber. The absorption equipment is inefficient and allows some of the hydrogen chloride gas to escape into the environment.

Solution: Replace existing absorption equipment with a more efficient type. Recover the hydrochloric acid vapors and use in subsequent operations.

Monetary Savings: Reduced costs for preparing absorption solution and lower hydrochloric acid requirements result in a **Savings of 8,000/year.**

Environmental Benefits: Reduced plant emissions and a lower salinity content in the waste water. Dissolved substances are reduced by 10 tons/year of which 3 tons are chlorides.

Project Completion Date: March 1995.

PROJECT NO. 3

Problem Area: In the manufacturing of absorbic acid, acetone vapors develop during the drying operation.

Solution: Modify the hot-air drying plant to capture the acetone vapors. This recovered acetone will then be used in other production processes. The entire plant, including the drying unit, is being refurbished and modernized.

Monetary Savings: Regeneration of the acetone results in a **Savings of $10,000/year.**

Environmental Benefits: Acetone emissions are reduced by approximately 20 tons/year.

Project Completion Date: December 1995.

PROJECT NO. 4

Problem Area: In operating the waste water treatment plant, solvent contaminants are released in the first stage of the bio-aeration tank. In addition, the pre-purification unit for waste water does not always function properly.

Solution: Plant proposes two solutions;
- For an immediate temporary solution, the plant will install a bio-filter unit to capture the solvent pollutants.
- The permanent solution requires the replacement of the first stage in the bio-aeration tank with an anerobic unit. The existing first stage must be replaced by the end of 1996. The installation of an anerobic unit would require an investment of approximately $1.0 million but would result in the following advantages:

- Total prevention of pollutant formation.
- Allows recaptured emissions to be used to generate heat at the plant's incineration unit.
- Improves efficiency of the waste water treatment facility.

Note: A final decision to install either a bio-filtration or anerobic unit depends on the privatization of the company.

Monetary Savings: Lower operating costs of the waste water treatment plant are relatively inconsequential.

Environmental Benefits: Prevention of pollution emissions.

Project Completion Date: Unknown.

BUSINESS CARDS OF FARMAKON REPRESENTATIVES ATTENDING DISCUSSIONS WITH WEC TEAM

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	Luder Stratil	Waste Water Management
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	Brock Neely	Volunteer Specialist
	Bohuslav Moucha	PPC Representative
	Rudolf Korinek	PPC Representative

COMPANY PROFILE. MCHZ is a large chemical complex that started operations in 1927. The firm is presently 88% privately owned, with the balance state-owned. The company's product line consists mainly of organic and inorganic chemical compounds for industrial applications, fertilizers and phenol-formaldehyde glues. The plant employs 1,600 workers and in 1994 had total sales of $100.0 million.

Part of the 1985 plant expansion included construction of a neutralizing station and a biological waste water treatment plant. An integral part of the plant includes environmental projects such as a unit for the recycling of sulphuric acid used in the production of nitrobenzene. In addition, a new project is proposed that will permit the plant to switch to a different source for hydrogen.

REVIEW OF PLANT'S THREE WMIP PROJECTS

PROJECT NO. 1

Problem Area: Various processes in the production of phenol-formaldehyd resins generates large amounts of waste water containing phenol. This water is distilled to remove the phenol, but the process leaves about 1,000 tons of solid toxic residue that is not permitted to be disposed of in the sanitation waste dump. It is imperative that the generated waste be reduced because, at the present time, it is being stored on site. The plant produces 5,000 tons/year of marketable resin, and in the process about 1,000 tons of nonsaleable product and about 10 tons of phenol are generated. The plant wants to maximize the amount of salable product and at the same time minimize waste material.

Solution: There are two options:

Revise the present dephnolization with an extraction technology that will allow the recycling of phenol and the reduction of solid waste resins by 90%.

- Develop a technology to utilize waste resins or neutralize the effects of the resins generated from the dephenolization of the contaminated waste water.

Monetary Benefits: Will be determined after the extraction technology has been finalized.

Environmental Benefits: Reduction in waste product requiring a landfill site.

Project Completion Date: Unknown at this time.

PROJECT NO 2

Problem Area: The production of nitro benzene and other amines produces a residue in the distillation column which requires special handing. The plant presently produces about 600-700 tons/year of residue which is incinerated. The emissions from the incinerator exceeds the allowable regulatory limits for air quality, and the plant is required to meet regulatory limits by the end of 1995 or face a shutdown.

Solution: Construction of a new incinerator to handle the accumulated residues as well as present production. The new incinerator is expected to reduce the emissions to meet regulatory limits.

Monetary Benefits: To be determined after new incinerator is on stream.

Environmental Benefits: Reduced emissions into the environment and neutralization of non-usable residues.

Project Completion Date: 1998.

PROJECT NO. 3

Problem Area: The plant uses ammonia to wash coke gas to extract hydrogen. In the process, the waste water is contaminated with NH_4^+. Of the 176 tons/year of NH_4^+ produced, 97 tons goes into the river, 41 tons winds up in the landfill, and approximately 38 tons go into the municipal waste water treatment plant. The 38 tons going into the waste water treatment plant is the problem. At present, the limit is 20 mg NH_4^+/litre and the 38 tons produced has a concentration of 150-200 mg NH_4^+/litre. The plant is fined for all waste over the 20 mg/litre limit.

Solution: Two solutions are possible:

- Change the technology by using natural gas instead of coke gas. This would result in the elimination of 41 tons of NH_4^+ that would ordinarily have gone into the waste water.

- Eliminate the amines and other inhibitors of the nitrification process. The plant hopes to convert the NH_4^+ to nitrate. This could lower the ammonia concentration to a level set by the municipal waste water treatment plant.

Monetary Benefits: Will be determined after the process technology has been finalized.

Environmental Benefits: Reduced ammonia ions going into the waste water and the river. Ends the practice of dumping waste water in landfill sites.

Project Completion Date: Unknown at the time.

REQUESTED WEC FOLLOW-UP

What process do U.S. firms use to make phenol formaldehyde?

BUSINESS CARDS OF (MCHZ) REPRESENTATIVES ATTENDING DISCUSSIONS WITH WEC TEAM

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	Juras Horvath	Technical Manager
	Kvetoslav Polasek	Chief Environment Dept.
	Lenka Prnkova	Assistant to General Director
	Elena Strculova	Ecology Department
	Vitezslav Vlcek	Owner and General Manager
WEC Team:	Frank Szymborski	Project Manager
	Ludmila Hofmanova	In-Country Coordinator
	Brock Neely	Volunteer Specialist
	Bohuslav Moucha	PPC Representative

COMPANY PROFILE: Ostramo was founded about 100 years ago as a petro-chemical plant. In 1940, it was reconstructed to operate as an oil refinery and in 1981 started operations to reclaim used oil. The firm was privatized in 1992 and is now the exclusive processor of used oils in the Czech Republic. The total annual plant capacity is 70,000 tons, but last year it processed only 22,000 tons of used oil. The firm has 400 employees and total annual sales of $11.0 million.

REVIEW OF PLANT'S ONLY WMIP PROJECT

Problem Area: The ground under the plant is extremely contaminated by oily residues resulting from the use of outdated oil-reclaiming techniques/processes. Plant's waste water has a high proportion of hydrocarbons and other ecologically harmful substances which are deposited in three open-surface lagoons immediately adjacent to a residential area. The plant has permission to use the existing waste water treatment procedures only until the end of July 1996. At the present time, about 250,000 tons of oil wastes contaminated with heavy metals and hydrocarbons are stored in the lagoons.

Solution: Plant has a two-step waste minimization program to eliminate the contamination problem;

- Immediate Solution (IS) - Utilize a bleaching clay aeration procedure and H_2SO_4 to treat the hazardous waste water.
- Long-Term Solution (LTS) - Involves the following steps;
  - Construct a new oil-reclaiming plant utilizing the "Meinken" system, see remarks for advantages.
  - Construct a functional plant drainage system.
  - Initiate soil and subsurface water decontamination procedures.
  - Monitor air pollution.

- Cover the three settling lagoons.
- Install a hydraulic protection system around the sludge-settling area.
- Monitor the sludge-settling area.
- Initiate subsurface water decontamination procedures in the sludge-settling area.

Note: The above procedure was recommended by U.S.-EPA.

Monetary Savings: A 5% saving in raw materials, plus a cost reduction in the treating of dangerous wastes and lower maintenance costs for the waste water treatment plant, results in the following:

- IS - **Savings of 15,000/year.**
- LTS - **Savings to be determined.**

Environmental Benefits:

- IS - Reduced soil contamination.
- LTS - Elimination of soil, water and air contamination, as well as minimizing potential fire hazards at the oil saturated lagoons.

Project Completion Dates:

- IS - July 1996
- LTS - 1998

REMARKS

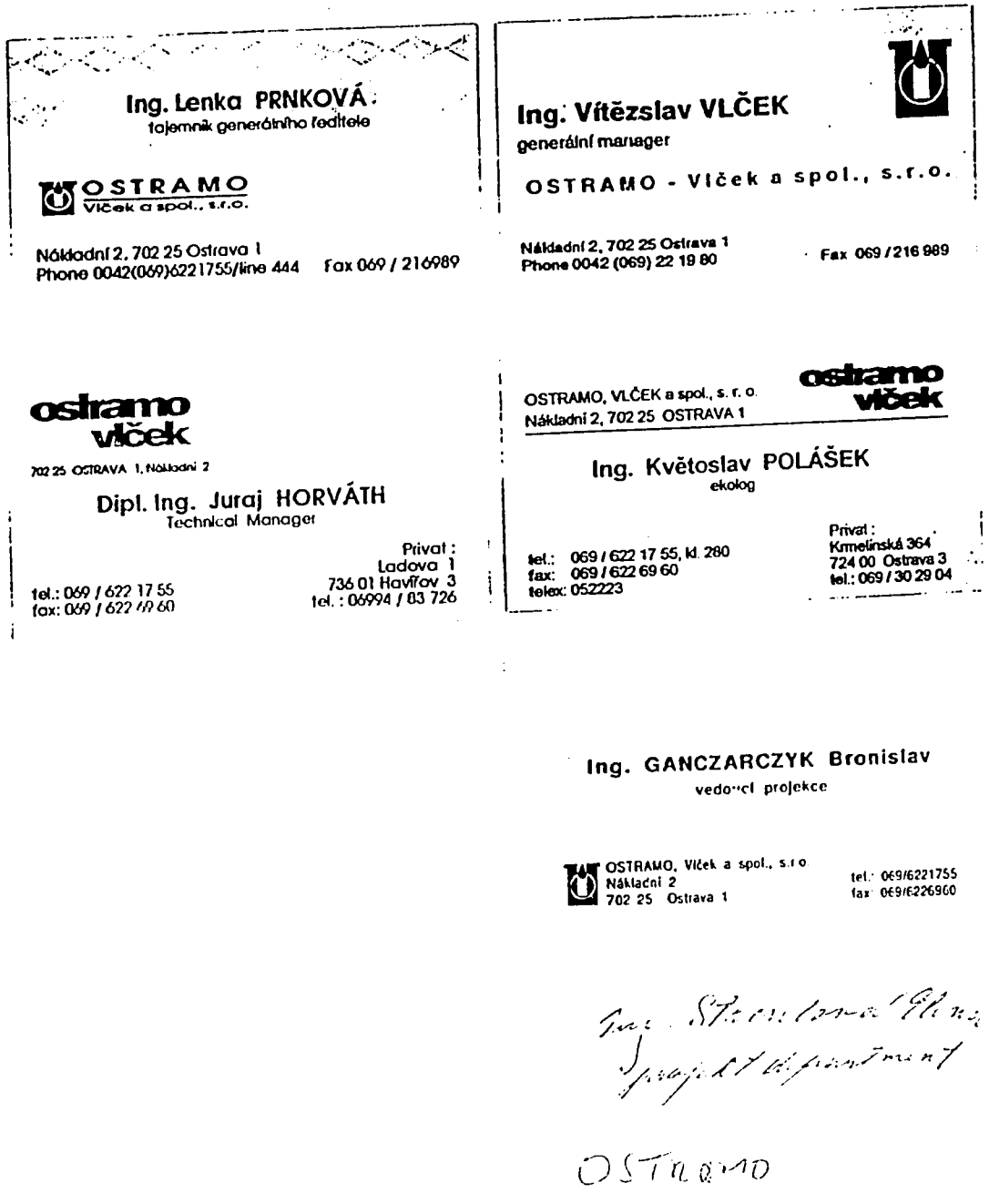
Utilization of the "Meinken" technology for regeneration of used oil offers the following advantages to Ostramo:

- Low initial investment, operating and maintenance costs.
- Equipment is user-friendly.
- Asphalt from the waste oil is suitable for the asphalt industry.
- Does not use H_2SO_4.
- The yield of the base oils and fuel oil from the dry used oil is greater than 90 %.
- The catalyst clay consumption is only 3.0-3.5%.

REQUESTED WEC FOLLOW-UP

How do U.S. firms handle the processing of used oils?

BUSINESS CARDS OF OSTRAMO REPRESENTATIVES PRESENT DURING VISIT TO PLANT



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OSTRAMO

PLANT VISIT REPORTS

OF

VOLUNTEER SPECIALIST

W. BROCK NEELY

TRIP REPORT ON

WASTE MINIMIZATION IN THE

CZECH REPUBLIC

JUNE 17-24, 1995

by

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July 1995

Disclaimer

The opinions expressed herein are the opinions of the author and do not represent the official position of the Government of the United States or the World Environment Center.

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I.EXECUTIVE SUMMARY

Project Scope:
The World Environment Center (WEC) arranged a trip to the United States for a group of top executives from 42 companies located in the Czech Republic, Bulgaria, Hungary, Romania and Slovakia. The purpose was to demonstrate the operation of a waste minimization program.

Following this introduction, two waste minimization workshops were conducted in the home country. Senior people attended the first workshop and lower level managers attended the second. Manuals were prepared for both workshops. The participating companies were given three assignments:

1. The General Director was to draft a waste minimization policy statement applicable to his company.
2. Using the manual as a guide the companies were to develop a waste minimization program.
3. Once the program was in place five small projects were to be identified that could be carried out immediately with a minimum of cost. These are described as, "TODAY" projects in the manual.

Major Findings:
1. Three of the four Companies visited were not prepared or did not understand the process of Waste Minimization as described in the Workshop Manuals. The fourth company, Ostrama Vlcek, did have an understanding and were actively working to minimize the waste in their operation.
2. Lachema had an excellent example of waste minimization. In the extraction of adamantane from the reaction mixture they had identified a new extraction solvent. The new solvent not only reduced air emissions but also resulted in a savings of $5,000 US dollars/year. The employees of this company need to be congratulated in applying the principles of waste minimization. However, it needs to be said that most of the projects outlined by Lachema showed little understanding of the process.

Recommendations:

1. Management should be encouraged to draft and circulate a waste minimization policy statement among the workers. It would be helpful to enlist the support of the employees in this endeavor.

2. Rudolf Korinek, a consultant emplyed by WEC, should work with these companies to insure that management as well as the employees understand the process.

3. The recommendations listed in section V could serve as a basis for each of the companies to formulate their individual action plans.

Follow up study:

Once there has been some strong evidence that Rudolf has had success in instructing the companies in the principles of waste minimization there should be a follow up trip made by WEC to see how well the program is working and to offer advice and suggestionsforimprovement

II. INTRODUCTION

Background of the mission:

The assignment of the "pro bono consultant" was to become familiar with the manual on Waste Minimization and visit four factories in one country with a member of the WEC staff and the WEC in country coordinator. The overall objective was to assess the progress being made by the companies in meeting the following goals:

1. Was a waste minimization policy statement applicable to the company in place?
2. How well were the companies performing in the development of a waste minimization program.
3. What sort of projects had been identified that could be carried out immediately with a minimum of cost?

The present assignment included four companies located in the Czech Republic.

The companies visited:

From June 18 to 23, 1995 the companies listed below were visited.

1. June 19, visit to Lachema in Brno.
2. June 20, visit to Farmakon in Olomouc
3. June 21 and June 22, visit to Moravske Chemicke Zavody and to Ostrama Vlcek, both companies are located in Ostrava.

The composition of the WEC team:

1. WEC Staff Frank Szymborski
2. WEC in country coordinator Luda Hofmanova
4. Rudolf Korinek - A Czech Engineer who works for Pollution Prevention Center (PPC). This is small group that is being funded by WEC. The purpose of the group is to follow through on the WEC plans and work with the various Czech companies.
5. Bohuslav Moucha - CEMC - He joined us in Ostrava. CEMC is an environmental management company. One of their projects is running PPC. In this capacity they employ Rudolph. Currently, CEMC and PPC are under contract to WEC.
3. Pro Bono consultant W. Brock Neely

Thanks to the full cooperation of the WEC professionals the visits were very successful. Due to this cooperation the recommendations developed in this report are accurate reflections on the state of implementation of the Waste Minimization techniques at the four companies visited.

The schedule of meetings and people visited are attached in Appendix D.

III. WASTE MINIMIZATION TECHNIQUES

The techniques used are described in Section V of this report.

IV FINDINGS

In what follows a brief description of the company and their proposed projects will be presented. The recommendations and conclusions are in section V.

1.Lachema,a.s., - This is a small private company devoted to the manufacture and marketing of small scale amounts of pharamceuticals and other specialty chemicals. In 1994 their sales were $40,000,000 US dollars. The Company is divided into three main divisions: 1. Organic chemicals, 2. Diagnostics and 3. Pharmaceuticals.

The main concern and the projects identified were in the first division. The projects are described below.

a.The company is concerned about the high discharge of carbon to the waste water system and hence to the river. The problem is very complex with 300 different products being produced by batch process. The managers identified material balance studies as one method of locating the reactions reponsible for the high discharge of carbon. Material balances were attempted on products produced in amounts greater than 500kg/year. This limited the number to 14 main chemicals. Preliminary analysis indicated more material going to the waste stream than is theoretically possible. Their proposal is to obtain COD monitoring equipment and to monitor the five effluent streams in an effort to locate the main source of organic discharge.

b. In the extraction of adamantane from the reaction mixture they have identified a new extraction solvent with a higher boiling point. This has resulted in a saving of over 1/3 of the solvent and $5,000.00 US dollars in raw material costs/year.

c. They are testing and evaluating the utilization of decaline. This is a material that originates from the isomerization of trimethylene nobornane. They hope to find a market for this chemical.

d. Continuing the long term study of the yield of norbornane isomerization and a proposal for a device to improve the extraction of adamantane.

e. A study of marketing the esterol product that is contaminated with acetic acid. If a market can not be found than the process will have to be improved leading to the next proposal.

f. Improving the yield of the esterification process in the hope of decreasing the amount of contaminant in the esterol product.

2.Farmakon - This small Company produces about 15 pharmaceutical chemicals and 14 other intermediates. All materials are produced in a batch process. This is a similar company to Lachema described above. At present (June, 1995) the company is state owned, they hope to complete the privatization by fall.

The projects identified were mainly concerned with air emissions. After observing how close residential apartments are to the fence line of the complex it is easy to see the reason for the emphasis on air emission. Further evidence for this concern was found on entering the town. In response to our question as to where the plant was located we were told by some of the citizens, "Oh you mean that 'smelly' plant". Air emissions are a problem! The projects follow:

i. To reduce the emissions of thionyl chloride and the decomposition products (SO_2 and HCL) from the aspirin chloride synthesis.

ii. To reduce the emissions from the synthesis of 2-(4-chlorobenzoyl) benzoic acid by 10%.

iii.To reduce the emissions by 10 % from the synthesis of Vitamin C.

iv. To reduce the emissions from the bio-aeration pond by 50%.

v. A catch all project to reduce the global emissions for the whole complex!

3.**Moravske chemicke zavody (MCHZ).** MCHZ is a large chemical complex employing about 1,600 people. The main products are Fertilizers, Inorganic and Organic Chemicals, Phenol Formaldehyde Resins and Industrial Gases. Total revenues in 1994 were about $100,000,000 US Dollars. Three projects were identified and discussed. Similar to the other companies all processes are batch rather than continuous.

i. The reduction of waste from the Phenol Formaldehyde Process. At present they produce 5,000 tons of marketable resin a year. In the process they produce about 400 tons of non saleable material and about 10 tons of phenol. The later ends up in the waste stream. Apparently there is no problem with formaldehyde waste. They have made a serious effort at examining the total process in an effort to minimize the waste and hence maximize the amount of saleable material.

ii. Reduction of NH_4^+ in the waste water. The Company uses ammonia to wash coke gas and extract hydrogen. In the process the waste water is contaminated with NH_4^+. Of the total amount produced (176 tons/year of NH_4^+) 97 tons enters the river, 41 tons goes to the landfill and about 38 tons enters the municipal waste water plant. It is this latter that is the problem. At present the limit is 20 mg NH_4^+/liter. The 38 tons produces a concentration of 150-200 mg NH_4^+/liter. The company is fined for everything over the 20 mg/L. There are two approaches being used to solve the problem.

- Changing the technology by using natural gas as opposed to coke gas. This will result in a saving 41 ton NH_4^+/year for a total of 135 tons.
- By eliminating amines and other inhibitors of the nitrification process the Company hopes to convert the NH_4^+ to nitrate. Hopefully, this will lower the ammonia concentration to a level set by the municipal waste treatment plant.

iii. The production of nitro benzene and other special amines. This process produces a residue in the distillation column that needs to be handled. Presently they produce about 600-700 tons a year which are being incinerated. The problem is that they have an accumulation of nearly 200 cubic meters(1,000 tons) which are being stored on site. Additionally, the present incinerator is not meeting air quality standards. Their solution is to build

a new incinerator (presently being built) which will handle the accumulated residues as well as current production. Simultaneously the new incinerator will generate emissions at or below the levels set by the government.

4.Ostramo Vlcek - This is a private company owned by one person, Vitezslav Vlcek. The operation consists of taking reclaimed oil and converting it back to saleable fluids. There are two main products; a motor oil and a gear oil. In the past year they processed over 22,000 tons of used oil, they have the capacity to reprocess 77,000 tons. A few years back they processed over 66,000 tons. The reclamation process produces a sludge high in heavy metals and unwanted hydrocarbon fractions. Over the years,300,000 tons have been accumulated and are stored in lagoons on site. This is a big problem and threatens to shut the plant down unless a satisfactory solution is found. The managers are searching for other products, if in fact the reclamation process is terminated. One such project is taking the monomer polyvinyl chloride (PVC) and extruding marketable PVC objects.

V CONCLUSIONS AND RECOMMENDATIONS

LACHEMA AND FARMAKON - The two companies are considering material balance studies, hence this recommendation applies to both. Reaction conditions for all the synthetic operations need to be investigated. These should be compared with the optimum conditions as reported in the literature. Where necessary the plant conditions should be made to conform to the ideal as closely as possible. As a suggestion it might be worthwhile to retain the services of a recognized Professor of Organic Chemistry to help in the study. Once the above investigation has been finished a material balance should be performed on the major processes. Since these are all batch type reactions a separate study needs to be performed for each batch. If a COD analyser is used than obviously the analysis needs to be correlated with the batch. In order to do this the retention time in the batch reactor needs to be known. Such data will indicate which synthetic operations needs further study. Parameters such as, leaky valves, length of reaction time, type of distillation column, operating temperature, etc. are a few of the items to study.

The next recommendations are specific for each Company.

LACHEMA The projects identified came from the top down. There was no indication that the workers had ever been involved in the decision making process. Effort should be made to involve more people in the projects. This general observation applies to all the companies interviewed.

Specific comments on the projects follow:

1. The material balance study has been addressed above.
2. The change in extraction technique for the adamantane process is great and an excellent example of what can be done with minimum cost. This project should be high lighted as an example of Waste Minimization.
3. The remaining projects are minimal. The study of the esterification process should apply to all the reactions that are being used by the company. Any change in process to improve yield and reduce pollution will be step in the right direction.

FARMAKON - All projects were described with the general goal of reducing emissions by a certain percent. This indicates little thought was given to the overall process that generates the waste. The recommendation was made that the projects should be reworked. Rudolf Korinek will work with the Company in this task.

MORAVSKE CHEMICKE ZAVODY- The phenol formaldehyde process is very old and there must be a wealth of information regarding the polymerization and the waste generated. Frank Szymborski will look into the American production to see what can be made available to these people.

The process of reducing NH_4^+ in the waste water is being looked at from a Waste Minimization point of view. It remains to be seen how successful they are. My only thought on the subject is to utilize a different approach to making Hydrogen gas. If a technique could be found that would fit their operation than the ammonia problem might disappear. For example the thermal decomposition of hydrocarbons for producing hydrogen gas is one possibility.

The synthesis of nitrobenzene should be examined to insure that the company is using optimum conditions. If the reaction could be optimized it might go a long way to reducing the emissions from the plant. If this is not possible than the acquisition and operation of a new incinerator becomes a solution.

OSTRAMA VLCEK- The management has a clear understanding of their problem. Furthermore, they are proceeding in a logical manner to minimize their waste. They have contacted the EPA in the United States and other companies in Western Europe for assistance. I would recommend that they contact companies in the United States for additional help. Perhaps Frank Szymborski could place them in contact with people who might help.

VI COST AND PAYBACK INFORMATION

I have no recommendations for this section of the report. Obviously, from reading the above account of my activities a great deal more data would be necessary to discuss costs and possible payback.

VII IMPLEMENTATION PLAN AND SCHEDULE

1. Management should be encouraged to draft and circulate a waste minimization policy statement among the workers. It would be helpful to enlist the support of the employees in this endeavor.

2. Rudolf Korinek should work with these companies to insure that management as well as the employees understand the process of Waste Minimization.

3. The recommendations listed in section V could serve as a basis for each of the companies to formulate action plans.

4. Frank Szymborski should provide contacts in the United States for the people at Moravaske dealing with the phenol formaldehyde process.

5. Frank Szymborski should provide American contacts for the people at Ostramo dealing with waste oil recovery.

Follow up study:

Once there has been some strong evidence that Rudolf has had some success in instructing the companies in the principles of waste minimization there should be a follow up trip see how well the process is working and to make suggestions for improvement.

VIII APPENDICES

A.PEOPLE CONTACTED

LACHEMA a.s.

1. Richard Machat	General Director
2. Ing. Josef Beran	Water Management
3. Ing. Ladislav Kadlec	Production
4. Ing. Jirl Jenlinek -	Dept. Of Technology
5. Rostilav Nebola	Strategy and Marketing
6. Ruzena Krivankova	Strategy and Marketing
7.Jan Kos	Technology Manager

Address:
Lachema a.s.,
Karasek 1,
621 00 Brno, Czeck Republic

FARMAKON

1. Richard Stribrny - I am not sure of his position. He left after a few minutes and we did not see him for the rest of the day.
2. Miloslav Tauber a technician who did some of the reporting.

Address:
Faramkon s.p.,
771 17 Olomouc, Czech Republic

MORAVSKE CHEMICKE ZAVODY

1. Thomas Pavelka - Director of Environmental affairs.
2. Jiri Drong, Development Manager
3. Mr. Ludek Stratil- Waste Water management

Address
Moravske Cheicke zavody Co., Ltd.

35

709 03 Ostrava Czech Republic.
Fax +42 69 42 50 3

OSTRAMO VLCEK

1. Vitezslav Vlcek - General Manager and owner
2. Juraj Horvath - Technical Manager
3. Lenka Prnkova - Technical Advisor
4. Ganczarczyk Bronislav - Chief of Project Department

Address:
Ostram Vlcek s.r.o.,
Nakadni 2, 702 25 Ostrava 1
Czech Republic
Fax 069 216 989

B. TOUR

Monday June 19 - Drove from Prague to Brno arrived about 10:30am and went directly into a meeting. The people listed above for Lachema proceeded to discuss their plans for implementing the Waste Minimization Program. About 2:00 pm we finished and returned to Prague.

Tuesday June 20 - Drove to Olomouc and a visit to Farmakon. Upon the conclusion of that visit we drove to the Hotel Atom in the city of Ostrava. That evening we had dinner and discussed with Pavelka and Moucha the problems at Moravske and world problems in general.

Wednesday June 21 - Visited with the people from the Moravske chemicke zavody Co. In the afternoon Frank, Luda and myself took a taxi tour of the surrounding area. Had dinner with Mr Moucha, Frank and Luda.

Thursday June 22 - Visited the Ostrama Vlcek plant and had a most informative session on their sewage problem. After a long lunch with the owner and his staff, Luda, Frank and myself went to the airport for our flight back to Prague.

Friday June 23 - Met with Luda, Frank and Rudolph to review are findings.

Saturday June 24- Leave for home.

C. RESUME FOR W. B. NEELY

Dr. Neely has had more than 30 years experience with the Dow Chemical Company working in a variety of research areas such as agricultural pesticide development, environmental exposure and fate, and antimicrobial development and toxicology. His main interest has been in the area of environmental chemistry where he has an international reputation in the field of modeling environmental systems having published a number of papers in this and related fields. He is a member of several scientific groups, including the American Chemical Society and the Society of Environmental and Toxicological Chemistry.

CONSULTING COMPETENCIES

Neely specializes in projects dealing with the environmental fate and exposure from chemicals. In this connection he has the expertise to develop mathematical models which can predict the movement of chemicals in various environmental media such as air, water and soil. This description is a necessary prelude to developing a risk assessment for the chemical in question.

Served as a member of the EPA's Scientific Advisory Board to help write the document dealing with Water Quality Criteria.

Served as a pro bono consultant for the World Environment Center in New York City. In this capacity visited and wrote a report on the Tiszai Vegyi Kombinat, Rt complex in Tiszaaujvaros in Hungary in July , 1993.

EDUCATION

B.A. in Chemistry University of Toronto	1948
Ph.D. in Biochemistry Michigan State University	1952
Post Doctoral Fellow Ohio State University	1953
Rockefeller Fellow University of Birmingham, England	1954

HONORS

Synthetic Organic Chemical Manufactures Association Gold Medal for Outstanding Contribution to the fields of Environmental Science, 1978.

PROFESSIONAL BACKGROUND

OF

VOLUNTEER SPECIALIST

W. BROCK NEELY

W. BROCK NEELY

POSITION	**Environmental Consultant**
EXPERTISE	Approximately 35 years experience in Environmental Research.
EDUCATION	University of Toronto, BS in Agricultural Chemistry. Michigan State University, Ph.D. in Biochemistry. Postdoctoral Training at Ohio State University & University of Birmingham, England.
EXPERIENCE SUMMARY	**Dow Chemical Co.:** Prepared Environmental Impact Studies and participated in national meetings to have the impact study accepted. Performed environmental audits for company's waste discharge points - for both air and water. Manager of Water Standards Group for CMA - coordinated efforts for several Chemical Companies. Industrial Task Force on Air Quality Standards. Performed research in both agricultural and environmental sectors. **Other Professional Experience:** Adjunct Professor of Chemistry - Saginaw Valley State University, University Center, Michigan. Chemistry Teacher - Johns Hopkins University. Drug Research - G.D. Searle, Skokie, Illinois. Biological Research - Fort Detrick, Maryland.
PROFESSIONAL ACHIEVEMENTS	Winner of SOCMA Gold Medal for outstanding research in Environmental Chemistry. Published several hundred articles regarding Environmental Chemistr Chairman of several different Industrial Task Forces involved in developing Environmental Regulations. Developed and published computer program for estimating the risk associated with hazardous chemical spills. Established professional consulting company - EnviroSoft, Inc. P.O. Box 2566, Midland, Michigan 48640.