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WORLD ENVIRONMENT CENTER

SLOVAK REPUBLIC

WASTE MINIMIZATION IMPACT PROGRAM

PROGRESS EVALUATION VISITS TO PLANTS

JUNE 5 - 9, 1995

PLANTS VISITED:

Chemes in Humene
Chemosvit in Svit
Novacke Chemicke Zavody in Novaky
Povazske Chemicke Zavody in Zilina

WORLD ENVIRONMENT CENTER
419 PARK AVENUE SOUTH, SUITE 1800
NEW YORK, NEW YORK 10016

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REPORT DISTRIBUTION:

Michael Kalinoski, Project Officer, Bureau for Europe and New Independent States, United States Agency for International Development

Patricia Lerner, USAID Representative, Bratislava, Slovakia

Patricia A. Swahn, Acquisitions Manager, Document Acquisitions, United States Agency for International Development

Olga Hauskrechtova, WEC Coordinator, Bratislava, Slovakia

Martin Hauskrecht, Pollution Prevention Center, Bratislava, Slovakia

Antony G. Marcil

George Carter

Thomas J. McGrath

Romuald Michalek

Bohdan Aftanas

B. Bhushan Lodh

Frank Szymborski

Valerie Sepe

Nik Mukhopadhyay

File

DISCLAIMER

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

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WEC would like to acknowledge Mr. Nik Mukhopadhyay, who gave freely of his time and expertise in assisting us in our work in the Slovak Republic.

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I. INTRODUCTION

During the week of June 27, 1994, under the technical assistance program to Central and Eastern European countries funded by the United States Agency for International Development (USAID), the World Environment Center (WEC) conducted a four (4)-day Waste Minimization Workshop in Sporna, Slovak Republic.

The purpose of the workshop was to introduce representatives of industry, consulting companies and government authorities to the waste minimization concept as it is being practiced in the U.S. to mitigate environmental pollution caused by industrial activities.

Subsequently, on November 16, 1994, a one (1)- day Waste Minimization Seminar was held in Bratislava. At this seminar, a practical ten step implementation waste minimization procedure as advocated by WEC was demonstrated to representatives from ten entities participating in the Waste Minimization Impact Program (WMIP). Also, it was agreed that each of these enterprises will implement a waste minimization program at their facilities based on the guidelines recommended by WEC.

June 5 through 9, 1995, WEC's team consisting of Mr. Nik Mukhopadhyay, volunteer specialist from Occidental Chemical Corporation, Ms. Olga Hauskrechtova, WEC in-country coordinator, Dr. Bohdan Aftanas, WEC Project Manager, and Mr. Pavel Jech, Director, Association of Industrial Ecology in Slovakia, visited the following four (4) industrial plants participating in the WMIP: Chemes in Humene, Chemosvit in Svit, Novacke Chemicke Zavody (NCHZ) in Novaky and Povazke Chemicke Zavody (PCHZ) in Zylina. The purpose of the visit was to review what progress has been made in implementing the commitments undertaken by these companies in connection with their participation in the WMIP.

Specifically,

- The General Director was to issue a waste minimization policy statement;
- The company was to establish a waste minimization program, including team structure, at all facilities; and
- The company was to identify and initiate the implementation of five small, short-term, no/low cost waste minimization projects.

An additional commitment undertaken by these companies was active participation in the industry-wide Waste Minimization Seminar at which they will present to other plants the projects they selected for implementation.

II. EXECUTIVE SUMMARY

During June 5 - 9, 1995, a World Environment Center (WEC) team visited the Republic of Slovakia to review the progress of the Waste Minimization Implementation Program at the following plants:

- CHEMES in Humenne
- Chemosvit in Svit
- Novacke Chemicke Zavody (NCHZ) in Novaky
- Povazske Chemicke Zavody (PCHZ) in Zilina

Summarized below are highlights of the observations made by the WEC team during the plant visits:

- All four plants have developed policy statements and are in the process of issuing them;

- All plants have established organized Waste Minimization programs headed by assigned persons;

- All plants have identified small projects that could be implemented easily. Some of the plants have identified all five small projects, whereas other plants have identified one or two large projects. For ease of implementation, WEC recommends that the large projects be broken down to smaller projects; and

- Reviews of plant operations indicate that there are potentials for waste minimization opportunities at some facilities, especially the older facilities, such as Novacke Chemicke Zavody (NCHZ) at Novaky and the Povazske Chemicke Zavody (PCHZ) at Zilina.

III. PLANT VISITS

Chemes
(June 5, 1995)

CHEMES produces and supplies energy and utilities in the form of heat, electricity, coolant and nitrogen to the adjoining Chemlon facility. In the past, both facilities were operating as one company.

The plant has an annual turnover of approximately $35 million/year and employs about 970 workers. A majority of the stocks are owned by the employees.

Mr. Lowesky is responsible for the environmental management activities of the plant. The plant has established a Waste Minimization Program supported by a statement from the General Director.

The plant has identified the following three major Waste Minimization projects, some of which WEC recommended to break down into smaller projects for easier implementation.

Project # 1: Solid Waste Recovery & Reuse

In 1994, the plant had generated and sent to the regional landfill approximately 4500 MTons of solid waste (papers, rags, plastics, steel, rubbish, etc.) at a cost of approximately $70,000. In 1995, the projected cost was estimated at $95,000.

A quick review by the project team revealed that over 40% of quantities of solid waste could be reused with reasonable effort. The major reduction plans include increased awareness for waste minimization, source segregation, recycle and reuse of the waste material internally and through the outside recyclers (for papers, glasses and steel parts).

The waste minimization team established the following reduction goals based on 1993 as the reference year:

- In 1995 - 40% reduction
- In 1996 - 20% reduction
- In 2000 - 40% reduction.

To this date, financial benefits of these measures have not been developed. However, it can be anticipated that when projected goals are accomplished, savings in handling solid waste in year 2000 will be at least in the range of **$400,000**.

The financial benefits of these reductions have to be developed by the plant.

Responsibility and accountability for the project has been established.

The solid waste also includes significant amounts of used mercury lamps which add to the disposal problem. Based on experience in the US, the WEC team recommended that the plant contact the lamp supplier so that the used lamps could be returned to them.

Project # 2: Disposal of Alkali Sludge

The plant generates approximately 4500 MTons/year of alkali sludge as a result of boiler feedwater treatment by lime and other chemicals. At present, the plant spends approximately $7,000/year for transportation and disposal of this material to the landfill.

The waste minimization team contacted the Soil Institute at Bratislava to investigate the possible utilization of this sludge. The Soil Institute determined that this sludge could be used as fertilizer for agricultural lands. In last year, the plant sold approximately 1500 MTons of this sludge to the farmers and plans to continue with this program. The financial impact of the project has to be calculated.

Responsibility and accountability for the project has been established.

Project # 3: Reduction of flyash (particulate emissions)

The plant has eight boilers. In some of the boilers, brown coal (high ash content) is used as fuel. As a result, they have significant particulate emissions from flyash.

The waste minimization team established for this project has developed five sub-projects to reduce the flyash emissions. The following approaches are being considered to achieve the reductions:

- Better control of air flow;
- Switching to alternate fuels, such as oil or gas;
- Improvement of refractory lining;
- Installation of cyclones and/or electrostatic precipitator;
- Improved process control by monitoring SO2, NOx and ash contents of the exit stream.

By installing a new cyclone at boiler # 3, the plant has been successful in achieving a reduction of flyash, resulting in savings of about **$9,000**/year. At boiler # 4, efficiency improvement of 5% has been achieved by the installation of an electrostatic precipitator. Several system monitoring and control programs are being considered for the boiler # 8. The plant is working with several equipment vendors to resolve and minimize the generation of ashes. It is also expected that significant improvement of boiler efficiencies can be achieved by improved process control and statistical analysis of the operational data to predict the operational conditions.

The boilers do not have flame control or any other analyzer/feedback mechanism. Except for one boiler, there are no computer control systems. It appears that this project is capital intensive and cannot be considered as a low cost/high yield project.

Chemosvit
(June 6, 1995)

Main production of Chemosvit is the printing of flexible packaging materials based on cellophane, polypropylene and polyethylene. This constitutes approximately 80% of their business. In addition, the plant produces fibers, specialty synthetic films and packaging machinery. The annual turnover is approximately $100 million/year and has about 3600 employees. It is a privatized company.

The plant has established a Waste Minimization Program supported by a policy statement from the General Manager. The plant operation is highly automated, modern and impressive.

Summarized below are the highlights of the five projects that have been selected by the plant.

Project #1: Minimization of residual inks in gravure printing operation

During the campaign of various gravure printings, paint residues are generated from roller troughs and roller and equipment clean up operations. Normally these residues are discarded as wastes, resulting in losses due to cost of raw materials and high disposal costs.

The waste minimization team has developed a scheme to segregate and recycle the paint in the next campaign, resulting in recovery from 3,000 tons/month to 10,000 tons/month and savings of approximately **$126,000**/year.

Mr. Peter Jablonovsky has the responsibility for the implementation of this project.

The WEC team suggested that the plant follow the principle of "Just in Time" (JIT) delivery system, resulting in fewer campaigns and reduced waste paints.

Project #2: Minimization of film wastes during production of film packaging materials

Significant amounts of film wastes are generated during the production of film packaging materials. These wastes are normally incinerated.

The waste minimization project team has developed a scheme to segregate the materials at the point of generation and then recycle them back to the process. The team has been successful in recycling approximately 50% of the material, resulting in an estimated cost savings of about $9,000 over a five month period, which would amount to approximately **$21,000**/year. The team plans to continue its program of recycling higher quantities of the materials.

Mr. Vladimir Bilek has been assigned to oversee this waste minimization project.

The WEC team recommended that the plant find markets where such film wastes can be used for other applications and can be sold directly without recovery and recycle.

Project #3: Minimization of CO and NOx emissions from boiler # 9

The plant has eleven boilers that use oil or gas as fuel. The plant is located in a pristine area of a national park and forest; therefore, the plant is subject to stringent emission limits for CO, NOx, etc.

The waste minimization project team has been successful in improving the thermal efficiency of the boiler #9 by switching to natural gas and achieving better process control in the combustion chamber. This change resulted in an improvement of 0.5% in thermal efficiency and approximately **$7,000**/year savings in fuel costs. The plant plans to implement the same program in ten other boilers in the near future. However, at the time of our visit, the plant had not established a target date or projected cost benefit for other boilers.

Mr. Peter Ferjancek, Sr. has been assigned as a leader for this waste minimization project.

During the visit, the WEC team made the recommendation of installing Low NOx burners or an ammonia injection system to further reduce the NOx generation.

Project #4: Minimization of Paint Consumption in Flexographic Printing Process

During the campaign of various flexographic printing operations, paint residues are generated from roller vanes and roller and equipment clean up operations. Normally these residues are discarded as wastes, resulting in losses due to the value of raw materials and high disposal costs.

The waste minimization project team has developed a scheme to recover, segregate and recycle the paint in the next campaign, resulting in savings of about **$53,000**/year.

Mr. Peter Sterbak has been assigned the responsibility for the implementation of this project.

A suggestion was made by the WEC team to follow the principle of "Just in Time" (JIT) delivery system, resulting in fewer campaigns and reduced waste paints.

Project #5: Minimization of Calcium Milk Waste

The plant uses calcium milk for neutralization of wastewater effluents. Calcium milk is produced by the slaking of lump lime in the slaking drum. A significant amount of residue is generated during the slaking operation due to the presence of high levels of inert impurities present in the solid lime. At present, this is disposed of in landfills.

The waste minimization team has been successful in identifying new suppliers of solid lime containing only 0.2% of inert materials (compared to 9% in the past). This change has resulted in 45 M'Tons/year of lime savings and cost savings of about **$2,300**/year.

Mr. Julius Frkan has been assigned the responsibility of implementing this project.

During the visit, the WEC team recommended purchasing and using calcium milk directly, thus avoiding the step of producing the lime milk.

Novacke Chemicke Zavody (NCHZ)
(June 7, 1995)

The plant produces a mixture of organic and inorganic chemicals. The major product lines include caustic, chlorine (using mercury cells), ethylene dichloride, vinyl chloride monomer, polyvinyl chloride, hydrochloric acid, polyvinyl acetate, acetylene, and

various surfactants. Starting from their own raw materials, they also produce several consumer products, such as vinyl floor coverings, vinyl window casings, etc.

The plant has an estimated turnover of $123 million for1995 and employs approximately 2500 men and women. It has been a public company since 1994 and is still undergoing several organizational changes, including formation of a partnership operation with ENICHEM, the Italian chemical company.

The plant has established a waste minimization program supported by the general director. A policy statement is being finalized.

The plant has selected a large waste minimization project which focuses on the reduction of surfactants discharged into the Nitre river. The surfactants are based upon ethoxy amines, ethoxy fatty acids and ethoxy and propoxy aliphatic or aromatic compounds. WEC's team indicated that the main project should be broken down to several smaller projects based on sources of generation of surfactants.

The waste minimization team has estimated a potential savings of approximately **$35,000**/year from this project when completed. The team has been successful in optimizing the use of surfactants in the PVC emulsion reactor clean-up operation, resulting in estimated savings of about **$18,000**/year. One of the ideas implemented involve washing the reactor after every 50 batches instead of after every few batches as in the past, thus resulting in a significantly reduced quantity of surfactants in the effluent.

In the areas of possible reduction of surfactant discharges from the tank wagon cleaning operation, the WEC team made recommendations to consider allocating tanks for dedicated product, thus minimizing the need for washing after tanks are returned empty from the customers. The WEC team also suggested that the increased use of bulk containers be considered for shipping and receiving of the products and raw materials, thus reducing the need for more drum washings.

The Technical Director has the responsibility for implementation of the project.

Povazske Chemicke Zavody (PCHZ)
(June 9, 1995)

The plant manufactures both organic and inorganic chemicals. The main product lines include manufacture of 6-caprolactum, methyl methacrylate (MMA), polymethyl methacrylate (PMMA), polyamide-6, ammonium sulfate, sulfuric acid and several fine chemicals. Based upon some of these products, the plant also manufactures floor coverings, window frames, kitchen sinks and various injection molding products.

The company's annual turnover is $70 million/year and has 1500 employees.

The plant has established a waste minimization program supported by the general director. An official policy statement has been drafted and will be issued shortly. The plant personnel has been involved with a Norwegian waste minimization program for over a year.

Only two waste minimization projects were identified for implementation.

Project #1: Waste Minimization of Polyamide Process

During the depolymerization step of the polyamide manufacturing process, significant amounts of residues are formed in the reactor, and are subsequently sent to landfills after each batch. Also, water solution of caprolactum from the depolymerization process contains various undesirable impurities which are adsorbed in carbon beds. The spent carbon is disposed of in landfills.

The waste minimization project team developed the following ideas to reduce the residues and impurities:

- Improvement of raw material quality;
- Switching to better quality carbon for adsorption;
- Regeneration of carbon by steam; and
- Process optimization to reduce residue formation.

It is estimated that the implementation of the above ideas could eliminate as much as 50% waste generation from this process, resulting in savings of approximately approximately **$140,000**/year. The team has completed an excellent cost/benefit analysis using a spreadsheet to prioritize the actions.

Mr. Richard Sladky is the team leader for this waste minimization project.

Project #2: Waste Minimization of MMA and PMMA Processes

During the process of manufacturing MMA and PMMA, liquid wastes are generated from the organic residues of the rectification and from the organic layer of storage tanks of the waste sulfuric acid. Also, a significant amount of solid wastes are generated in the esterification reactor and from the storage tanks of the waste sulfuric acid. At present, all of these wastes are incinerated.

The waste minimization project team has developed the following recommendations for implementation:

- Combination of waste acid with sulfur to produce sulfur dioxide to be used in the process;
- Addition of inhibitor during the amidation reaction step to prevent pyrolysis of product;
- Substitution of sealing materials to prevent formation of residues; and
- Improvement of mixing in the reactor by improved nozzles.

The waste minimization team developed cost/benefit analysis and prioritized the options for implementation. It was estimated that implementation of the first two options will yield approximately **$21,000**/year of savings.

The project has been assigned to Mr. Marcel Haver and Mr. Miroslav Sabo for implementation.

The WEC team recommended that the plant secure raw materials of better quality and improve the process control system in order to reduce the residue formation during the reaction step.

IV. BUSINESS CARDS OF CONTACTS

Dušan SMINČÁK
Production Director

CHEMOSVIT CHEM, Ltd.

059 21 Svit - Slovakia
Tel.: 0042/92/56263 Fax: 0042/92/55886 Telex: 078 232-3

Vladimír BALOG
Finance Director

CHEMOSVIT CHEM, Ltd.

059 21 Svit - Slovakia
Tel.: 0042/92/56614 Fax: 0042/92/56580 Telex: 078 232-3

Chemosvit CHEM
akciová spoločnosť
Štúrova 101, 059 21 SVIT
SLOVENSKÁ REPUBLIKA

Dipl. Ing. Peter Ferjančeк
životné prostredie

Tel.: 092/55011-19
kl.2017,2141

Telefax: 092/56580,
55864

C H E M O S V I T
FARBY A LAKOVNE / FARBE

Ing. Peter Jablonovský
technológ farieb

CHEMOSVIT 059 21 Svit
Telefón : 092/550 11-19 kl. 2897 Fax: 092/55885

CHEMOSVIT 059 21 SVIT SLOVENSKO

Ing. JÚLIUS FRKÁŇ
technológ divízie komplexného
spracovania druhotných surovín

Telefón: 092/55011 kl. 2393
Telex: 078232-3
Telefax: 042/92/56580

Privat:
L. Svobodu 2568/38
058 01 Poprad-Juh

Ing. Peter Šterbák
vedúci ORKK PE výrobkov
a flatych fólií

CHEMOSVIT CHEM a.s.
059 21 SVIT SLOVENSKO

tel.: 092/ 55011-19 kl.2273, 2064
fax: 092/55879
telex: 078/232-3

Chemosvit CHEM
akciová spoločnosť
Štúrova 101, 059 21 SVIT
SLOVAK REPUBLIC

Milan ĎURČA
Technical Department

Tel.: 0042/92/550 11-19, kl. 2952 Telefax: 0042/92/558 64

Chemosvit CHEM,
akciová spoločnosť
Štúrova 101, 059 21 SVIT
SLOVENSKÁ REPUBLIKA

Ing. Jaroslav Šugarek
vedúci oddelenia výroby tepla a úpravy vody

Tel.: 092/ 55011-19 kl. 2513
Tel.: 56769

Fax: 092/ 56955

CHEMOSVIT, akciová spoločnosť
Štúrova 101, 059 21 SVIT
SLOVENSKO

Ing. Michal DROBNÝ
vedúci divízie SO a VO

Tel.: 092/56860
Fax: 042/92/56580

Privat:
Tel.: 092 55397

PCHZ

Dipl. Ing. Ján PILNÍK

Head of Envir. Dept.

Považské chemické závody

M. R. Štefánika 71
010 39 Žilina

tel.: (089) 304 55-8
fax: (089) 529 13
telex: 752 25

PCHZ

Dipl. Ing. Hugo MOLNÁR

Považské chemické závody

M. R. Štefánika 71
010 39 Žilina

tel.: (089) 304 55-8
fax: (089) 529 13
telex: 752 25

PCHZ

Ing. Miroslav SABO

TECHNOLOGIST FOREMAN PRODUCE AND FOR CLEANING OF WASTE WATER

Považské chemické závody

M.R.Štefánika 71
010 39 Žilina

tel.: 089/675 581, 630015-18
fax.: 089/529 13
telex.: 752 25

PCHZ

Dipl. Ing. Viliam ŠVEHLA

Považské chemické závody

M.R.Štefánika 71
010 39 Žilina

tel.: 089/304 55-8, 630 015-8
fax.: 089/529 13
telex.: 752 25

NCHZ NOVÁCKE CHEMICKÉ ZÁVODY NOVÁKY

Ing. MIROSLAV KOVÁČ

Ochrana životného prostredia
Umweltschutz-Environment Protection

972 71 NOVÁKY
Slovenská republika
Phone: (0862) 9295-2295, 3978 operátor
(0862) 9208-2295, 3978 aut.
Telex: 722 96
Telefax: (0862) 922 221

NCHZ NOVÁCKE CHEMICKÉ ZÁVODY NOVÁKY

Ing. LADISLAV KLAČANSKÝ

Ochrana životného prostredia
Umweltschutz-Environment Protection
972 71 NOVÁKY
Slovenská republika
Phone: (0862) 9295-2172 operátor
(0862) 9208-2172 aut.
(0862) 922 686
Telex: 722 96
Telefax: (0862) 922 221

NCHZ NOVÁCKE CHEMICKÉ ZÁVODY NOVÁKY

Ing. Ján KOSTKA

generálny riaditeľ a predseda predstavenstva
General Director and Board of Directors - Chairman

972 71 NOVÁKY
SLOVENSKÁ REPUBLIKA
PHONE: (0862) 9295-2000 operator
(0862) 9208-2000 aut.
(0862) 923 496
FAX: 922 009

Private:
971 01 PRIEVIDZA
Dlhá 48/46
Phone: (0862) 265 73

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CHEMES

066 33 HUMENNÉ
SLOVAKIA

Dipl. Ing. ŠTEFAN BRINKOŠ

director of technical services

CHEMES a. s.
Chemlonska 1
Tel. 0933 63 342
Tlx.: 076 216, 076 325
Fax: 0933 64 342
DIČ: 31695426/703
VÚB č. ú.: 408532 / 0200

CHEMES

IVAN MATIAS

general manager

Chemlonska 1
066 33 Humenné
Slovakia

Tel.: 042 / 0933 / 67 250
Fax: 042 / 0933 / 62 837

JÁN ALEXOVIČ
Research & Technical Service

Chemlon a. s.

CHEMLONSKA 1, 066 33 HUMENNÉ, SLOVAKIA
TELEPHONE: (0042) 0933-589-2337

CHEMES

066 33 HUMENNÉ
SLOVENSKÁ REPUBLIKA

DIPL. ING. PETER MAURITZ

Power Production Manager

CHEMES a. s.
Chemlonska 1
Tel. 0933 63 911
Tlx. 76 325
Fax 0933 63 911
IČO: 316 954 26
DIČ: 316 954 26/703
VÚB č. ú.: 408532 / 0200

PRIVAT:
ul. Trebičska 10
066 01 Humenné
Tel. 0933/63 392

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V. PROFESSIONAL BACKGROUND OF WEC VOLUNTEER SPECIALIST

PROFESSIONAL BACKGROUND OF WEC VOLUNTEER SPECIALIST

NIK MUKHOPADHYAY

BACKGROUND SUMMARY:

Twenty-five years of domestic and international management and hands-on experience in environmental, manufacturing, engineering, process development, acquisition, strategic planning and quality improvement in fine organics, pharmaceuticals, and petrochemicals industries achieving cost and quality objectives.

EXPERIENCE & ACCOMPLISHMENTS

Baker Environmental, Inc., Pittsburgh, Pennsylvania (1991 - 1993)

Manager, Process/Environmental Services

Responsible for overseeing environmental compliance, pollution prevention/waste minimization and process engineering services to chemicals, pharmaceuticals and petrochemicals industries.

- Developed and implemented marketing strategies to offer Baker's services to chemicals, pharmaceuticals and petrochemicals industries in the U.S. and Europe.
- Identified acquisition candidates to support strategic goals.
- Served as Project Manager for VOC Control Technology Project (AIChE/CWRT), TCA Elimination/Minimization Project (Merck Pharmaceuticals), and Waste Minimization/Pollution Prevention Audit and Training (AZOTAS, Republic of Lithuania)

CIBA-GEIGY Corporation, Ardsley, New York (1978 - 1991)

Director of Environmental Affairs (1988 - 1991)

Responsible for ensuring environmental compliance for a $3.5 billion corporation with 20 sites throughout the country.

- Provided a pro-active role in developing long-term strategic plan for air emission control for the corporation based on the proposed Clean Air Act amendments.
- Instituted waste minimization program at all sites resulting in approximate annualized savings of $2 million.
- Successfully implemented the development of a corporate-wide environmental data management system to ensure full compliance.
- Developed environmental compliance guidelines for the corporation to ensure implementation of all environmental laws and regulations for air, water and solid effluents.
- Provided leadership in organizing and implementing environmental audits of treatment, storage and disposal (TSD) facilities.
- Recommended building a new ultra-violet stabilizer plant based on an environmentally improved process resulting in approximately 50% reduction in manufacturing costs.

Director of U.S. Additives Production/Operations (1983 - 1988)

Responsible for the operations of five major manufacturing plants with an operating budget of $50-$60 million. A member of the Additives Operating Committee spearheading manufacturing plans for the division.

- Increased the capacities of antioxidants and ultra-violet stabilizer plants by 30% and 25%, respectively, by process optimization without capital investments resulting $7 million annual savings.
- Negotiated favorable pricing for major contracts for toll processing and for the purchase of strategic raw materials resulting in annualized savings of $1.5 million.
- Implemented quality improvement process at all sites based on the principle of statistical process control (SPC). Initiated quality audits for customers and suppliers.

Staff Engineer (1978 - 1983)
Responsible for commercialization of new products and recommendations of cost reduction and waste minimization programs for existing processes, profitability analysis, evaluation of potential acquisition candidates and supervision of technical personnel.

- **Recommended building a new basic liquid epoxy resin plant based on a new process technology resulting in approximately 20% reduction in manufacturing costs.**

Sherwin Williams Chemicals, Cincinnati, Ohio **(1975 - 1978)**
Project Manager
Supervised a group of engineers for plant expansions including process design, piping and instrument diagram review, vendor contacts and development of operating procedures.

- **Instituted cost reduction and productivity improvement programs in Triazole plant resulting in annual savings of approximately $1 million.**
- **Supervised the design of methyl anthranilate plant expansion.**

C.F. Braun & Company, Murray Hills, New Jersey (1974 - 1975)
Senior Chemical Engineer
Responsible for process plant design and refinery expansion including piping and instrument diagram review, vendor contacts, development of operating procedures and supervision of engineers.

- Successfully completed a major expansion project for Chevron Refinery in New Jersey.
- Designed Urea plant for NIPAK in Pryor, Oklahoma.

Tenneco Chemicals, Inc., Fords, New Jersey **(1968 - 1974)**
Production Manager
Responsible for supervision of daily production activities, implementation of productivity improvement program, management of environmental and safety issues, quality assurance, budgeting, capital expenditure planning, start-up of Formaldehyde, Benzaldehyde and Maleic Anhydride plants (continuous and batch processes), trouble-shooting of processes, supervision of foremen and unionized operating personnel, handling of grievances and arbitrations.

- **Responsible for achieving 25% reduction in manufacturing costs of chloro-toluene derivatives by process optimization.**

EDUCATION/PROFESSIONAL ACTIVITIES/PUBLICATIONS

- M.S. (Chemical Engineering) - 1968 - University of Colorado, Boulder, Colorado
- B.S. (Chemical Engineering) - 1966 - Jadavpur University, Calcutta, India
- B.S. (Chemistry) - 1962 - University of Calcutta, India

- Phil Crosby Quality College
- University of Tennessee - Quality & Productivity Improvement School
- Rutgers University - Management Seminars
- Princeton University - Executive Management Program

Past Chairman - Rhode Island Chapter of American Institute of Chemical Engineers; Member - American Institute of Chemical Engineers; Member - Air & Waste Management Association; Named to Who's Who in East

- "Successful Techniques for Achieving Pollution Prevention/Waste Minimization" by Nik Mukhopadhyay, Air & Waste Management Association Annual Meeting, 1993, Denver, Colorado.
- "Current & Potential Future Industrial Practices for Reducing & Controlling Volatile Organic Compounds" by Nik Mukhopadhyay and E.C. Moretti, Chemical Engineering Progress, July, 1993.
- "Current & Potential Future Industrial Practices for Reducing & Controlling Volatile Organic Compounds" by Nik Mukhopadhyay and E.C. Moretti, AIChE Summer National Meeting, 1993, Seattle, Washington.

PROFESSIONAL BACKGROUND OF WEC VOLUNTEER SPECIALIST

NIK MUKHOPADHYAY

Feasibility Studies, Process Development, Engineering Design & Construction. Manufacturing, Quality Improvement and Environmental Management experience for the following product lines/industries:

1. Formaldehyde
2. Benzaldehyde
3. Maleic Anhydride
4. Chloro-toluenes (e.g., Ortho/Para chlorotoluenes, Ortho/Para chloro benzaldehydes, Ortho/Para chlorobenzoic acids, etc.)
5. Urea
6. Triazoles (Benzotriazoles and Toluotriazoles)
7. Methyl Anthranilate
8. Epichlorohydrin
9. Epoxy Phenol Novolacs/Epoxy Cresol Novolacs
10. Epoxy Resins (Basic Liquid Resins and other specialty resins, e.g., Araldite)
11. Antioxidants and Heat Stabilizers for plastics (e.g.,IRGANOX, Chimassorb, etc.)
12. UV Light Stabilizers for coatings and plastics (e.g., TINUVINS, HALS, etc.)
13. Caustic & Chlorine
14. Petrochemicals (Benzene, Xylene, Butadiene, etc.)
15. PVC & VCM