WORLD ENVIRONMENT CENTER

ENVIRONMENTAL ASSESSMENT

SLOVENSKY HODVAB

SENICA, SLOVAK REPUBLIC

JUNE 21 TO JULY 2, 1993

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INTRODUCTION

In June of 1993, Mr. Daniel Chellaraj, under the sponsorship of the World Environment Center (WEC), traveled to the town of Senica, Slovak Republic, where he performed an environmental review of the Slovensky Hodvab synthetic fibre plant. What follows is Mr. Chellaraj's report on his observations and recommendations concerning environmental management at the plant.

Sponsorship of volunteer specialists like Mr. Daniel Chellaraj is one of the many activities carried out by the World Environment Center within the framework of its Technical Assistance Program for Central and Eastern Europe which is funded through the United States Agency for International Development. The World Environment Center acknowledges Mr. Daniel Chellaraj who gave freely of his time and expertise in assisting us in our work in Central and Eastern Europe.

II. EXECUTIVE SUMMARY

The purpose of this two-week trip was to conduct an overall plant environmental assessment, including a review of information provided by the plant on workers' health and safety. The main issues under review were air and water pollution. It should be noted that the review was limited to areas of conventional rayon only.

Wastewaters generated at Hodvab are being treated at pollution control facilities owned and operated by the plant. It seems that those facilities are not providing proper treatment and the effluent doesn't meet requirements. Specifically, the Biochemical Oxygen Demand (BOD) and Dissolved Solids (DS) are too high, substantially exceeding allowable limits. For BOD this limit was set at 26 mg/l whereas the plant effluent BOD is well in excess of 60 mg/l. Zinc content in the effluent is only slightly above regulatory limits.

The plant has taken steps to reduce the concentration of dissolved solids in the effluent by installing a Glauber salt plant to recover sodium sulfate. It should be noted that regulatory demands regarding discharge limits can be considered as quite stringent and difficult to comply with. Most likely this was due to the fact that the plant effluent receiver Triplica is a small stream originating as an overflow from the nearby water reservoir.

Final disposal of wastewater treatment plant sludges also presents a problem due to the insufficient capacity of the existing incinerator.

Power generation facilities use fuel oil with a relatively high content of sulfur, causing a sulfur dioxide emission into the air. However, it is the plant management consensus that substitution of fuel oil with natural gas will eliminate this problem. This may enable the plant also to utilize the calorific value of carbon disulfide and hydrogen sulfide exhausted from the spinning hall along with natural gas exhaust to maintain the allowable concentration of sulfur dioxide discharged through the stack.

One of the objectives of the trip was to make recommendations on how the operation of the plant might be improved from an environmental point of view. It was quickly discovered that the company was run by a well-trained and highly motivated group of managers. This was reflected in the general overall feeling of neatness that was in evidence while walking around the plant.

As with any organization, there is always room for improvement. The following are a few of the areas that emerged from conversations with the staff at Slovensky Hodvab.

1. Automatic Biochemical Oxygen Demand sampler should be installed to lower BOD contents in the wastewater treatment plant effluent;

2. Efforts need to be made to develop a method of final disposal of wastewater sludge;

3. Consideration should be given to discharge treated wastewater into municipal sewer system;

4. The plant should proceed with substitution of fuel oil with natural gas at power generation facilities;

For more detailed discussion of these and other recommendations, refer to the main report.

III. FINDINGS AND OBSERVATIONS

The Slovensky Hodvab plant is located in the town of Senica, Slovakia, 90 kilometers northeast of Bratislava. Slovensky Hodvab is a state-owned enterprise with 840 people working in three shifts. They manufacture bright and dull rayon filament yarn, polyester yarn and industrial polyester fibers. The plant produces 3000 T/year of rayon filament yarn, 11000 T/year of polyester fiber and 3000 T/year of industrial polyester fibers. The industrial polyester fiber plant is idle for lack of market.

The viscose process used by the plant is one best known for making regenerated cellulose (rayon) by converting cellulose to the soluble xanthate, which can be spun into fibers and then reconverted to cellulose by treatment with acid. Wood pulp is steeped with 17-20% caustic soda; the resulting alkali cellulose is pressed to remove excess liquor and the soluble beta and gamma cellulose, and then shredded and aged. It is then treated with carbon disulfide and sodium hydroxide to form an orange, viscose solution of cellulose xanthate. After filtration and deaeration, this solution (viscose) is forced through minute spinneret openings into a bath containing sulfuric acid, sodium sulfate and zinc sulfate. The salts cause the viscose to gel immediately, forming a fiber of sufficient strength to permit it to be drawn through the spin bath under tension. At the same time, the sulfuric acid decomposes the xanthate, converting the fibers to cellulose, in which form they are washed and dried. The rayon filament produced is of white bright and dull varieties. The yarn is then given the necessary twist and is taken to purification section (after treatment) and finally dried and humidified to regain the required moisture in yarn.

The spin bath in which viscose is extruded is composed of sulfuric acid, sodium sulfate and zinc sulfate. The volume of spin bath increases as the yarn is extruded from viscose resulting in wastewater. This will be considerably reduced when the plant starts running a Glauber salt unit. Sodium hydroxide reacts with acid in a spin bath producing sodium sulfate and water. Spin bath concentration is maintained by the addition of sulfuric acid. Recovered zinc and sodium sulfate are used to maintain the concentration of salts as required as all these constituents get reduced in concentration from water in viscose and water produced from acid and alkali neutralization.

Slovensky Hodvab has a water pollution problem caused by a high concentration of Biochemical Oxygen Demand and Dissolved Solids present in the wastewater treatment plant effluent discharged into the Triplica stream. Zinc concentration, pH, temperature and oil and grease are well controlled and are within required limits. The plant pays a penalty only for exceeding BOD and DS limits. The penalty for dissolved solids will cease as soon as the Glauber salt unit is

commissioned. The spinning hall is well ventilated and concentration of hydrogen sulfide is well within limits, i.e. less than 10 ppm. In short, the hall is comfortable for the spinners to work. The spin bath is clear and no salt is deposited on the godets and guides. This greatly assists in minimizing a lower quality of rayon due to broken filaments.

Workers' health is well taken care of by providing them with work clothing, gloves and shoes. Milk and vitamins are also supplied to the spinners. The spinning hall is a safe place to work as they do not have high speed rotating pots to receive the yarn like many other rayon plants. (These pots can fly out if the seating is not perfect and cause injury to the spinners). In addition to all the plus points which the plant has, is the absence of manufacturing units for raw materials to produce rayon, namely pulp, sulfuric acid, caustic sodas and highly toxic and flammable carbon disulfide. Because of this the factory does not deal with sulfur, charcoal and chlorine, which are major chemicals subject to environmental control.

IV. CONCLUSIONS AND RECOMMENDATIONS

Neatness and pride are the words that come to mind as one walks around the plant. It was obvious from the care with which people tidied up their workplace that they really love the plant. The process facilities were clean, and for the most part, had safe working conditions.

The following are recommendations for environmental improvement which resulted from discussions with management and from personal observations. They are listed in order of priority:

1. BOD level in the wastewater treatment plant effluent should be lowered to meet regulatory standards. It seems that the reason for difficulties with removing BOD is the ethylene glycol contents in wastewater originating from the polyester plant. Ethylene glycol, being highly toxic, may be reducing the efficiency of the biological treatment facilities. To provide better control of ethylene glycol concentration in the wastewater stream from the polyester plant, an automatic BOD tester should be installed. This instrument produces results in several hours as opposed to the standard five day test. This automatic instrument eliminates the need for sample dilution, chemical mixing and other such time consuming tasks.

2. Efforts should be made to dispose of wastewater sludges including removal from existing lagoons. In addition to incineration, consideration should be given to other final disposal methods.

3. Consideration should be given to discharging wastewater treatment plant effluent into the nearby municipal sewer system.

4. The plant should proceed with their plans to substitute fuel oil with natural gas at the power generation facilities to reduce sulfur dioxide emissions. This will also enable the destruction of carbon disulfide and hydrogen sulfide gases generated from the spinning hall. With this system, it is expected that the desired concentration specified by regulatory authorities can be reached. At present, about 50% of carbon disulfide is removed from rayon cake using the Lurgi process.

5. Efforts need to be made to implement plans to reduce freon emission from the refrigeration units which are being used for conditioning viscose. Consideration should also be given to completely eliminating freon and substituting an environmentally acceptable refrigerant.

6. Consideration should be given to removal of hydrogen sulfide from stack gases by diverting about 50% through a sodium hydroxide absorption tower to convert to sodium sulfide. Sodium sulfide could then be used as a desulfurizing agent in rayon purification system (after treatment). This will result in decrease of hydrogen sulfide going out in the stack, thus creating less of an odor problem in the vicinity of the plant (even 0.3 - 0.4 ppb of hydrogen sulfide can cause an odor nuisance) with a corresponding reduction in the sodium hydroxide consumed in the process.

V. APPENDICES

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CURRICULUM VITAE OF AUTHOR

DANIEL J. CHELLARAJ
Chemical Engineer

EXPERIENCE

I Senior Environmental Employment Program, American Association of Retired Persons (AARP), U.S.Environmental Protection Agency(USEPA), Washington, D.C., 1989 - Present
Chemical Engineer, Emergency Response Division, to provide technical assistance to develop the proposed rule on Reportable Quantity adjustments for hazardous chemicals and to review petitions from chemical companies to delete chemicals from Sec.313 of the Emergency Planning and Community Right-to-Know Act.

II Commonwealth of Virginia, Richmond, 1981 - 1988
Chemical Engineer, Water Control Board, supervised industrial waste treatment facilities and pre-treatment of toxic and industrial wastes. Took enforcement action on parties not complying with permit regulations.

III JRB Associates, Inc., McLean, Virginia 1980 - 1981
Provided technical assistance to USEPA in areas related to effluent treatment and discharge from industrial plants before it got discharged to sewage treatment plants.

IV George Washington University, Washington, D.C. 1977 - 1980
Production Control Supervisor - coordinated and scheduled activities of various work centers. Completed graduate courses in Environmental Engineering.

V J.K.Synthetics (Rayon), Kanpur, India, 1967 - 1977
Senior Chemical Engineer responsible for rayon purification and dyeing, process steam generation and supply, and water and wastewater treatment plants. Conducted investment studies to develop the process package for the viscose film project with British collaboration.

VI Travancore Rayons, Rayonpuram, India, 1951 - 1967
Process and Maintenance Supervisor for cellulose film casting, dyeing, coating and conversion and production of carbon disulfide.

EDUCATION

B.S. in chemistry and post-graduate degree in Chemical Engineering, Madras University, India.
Graduate Courses in Environmental Engineering and Law, George Washington University, Washington, D.C.
Short courses in Quality Control, Preventive Maintenance, and Executive Development Program.

PROFESSIONAL MEMBERSHIP, and other activities

American Institute of Chemical Engineers
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Water Environment Federation, active in Government Affairs committee
For International Executive Service Corporation as a Volunteer Executive, assessed and advised steps to abate pollution of Kingston Harbor, Jamaica, West Indies. In Barranquilla, Colombia, South America, advised Quimica International, a chemical manufacturing company, how to minimize polluting air and water.
For World Environmental Center as a Volunteer Specialist, studied and recommended waste minimization at Sodi Ltd., a huge soda ash production facility in Devnya, Bulgaria. Advised Polish Government facility "Organika-Zachem", a dyestuff manufacturing unit, to reduce polluting the river Fistula which discharges to Baltic Sea.