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TRIP REPORT #1 SVILOSA CO.

SVISHTOV, BULGARIA

WASTE MINIMIZATION PROJECT

OCTOBER 17 - 23, 1993

**WORLD ENVIRONMENT CENTER
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File

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I. ITINERARY

- o October 17, 1993 - Arrival in Svishtov
- o October 18 - Meeting with various Svilosa Company Managers to discuss the project
- o October 19 - 20 - Tour of facility - continue discussions
- o October 21 - Conclude tour and present findings; departure for Sofia
- o October 22 - Debriefing of U.S. AID representative in Sofia (on telephone)
- o October 23 - Departure from Sofia to U.S.

II. EXECUTIVE SUMMARY

WEC's team consisting of Mr. Raghu K. Raghavan, President, Envirometric Systems, Inc.; Mr. Daniel J. Chellaraj, pro bono specialist; and Dr. Bohdan Aftanas, WEC staff, made a reconnaissance trip to the Svilosa Company - Chemical Fibre Plant in Svishtov, Bulgaria. The purpose of the visit was to establish the feasibility of a Waste Minimization Demonstration Project (WMDP) and to select process facilities for such project. From October 18 through 21, 1993, WEC's team held a number of meetings with plant management as well as various other personnel and made a detailed review of the process facilities, to explore the opportunities available for conducting a WMDP. Plant management indicated great interest in such project which was reflected by, among other things, their outstanding cooperation and gracious hospitality extended to WEC's team. It should be noted that the company is run by a very well trained and highly motivated and efficient group of managers, which became more obvious while touring the plant when a general overall feeling of neatness was evidenced.

Following discussions and mutual consultation, it was concluded that conducting a WMDP at the Spinning Hall is feasible. The project will focus on air quality at this facility, aiming for a reduction in the concentration of carbon disulfide in the air and creating better working conditions for personnel employed in the Spinning Hall. It is anticipated that these improvements, in addition to resulting in health benefits, will generate financial savings from:

- (1) reduced production of waste yarn at the plant due to increased presence of operators in the area and better attention being given to the spinning operations; and
- (2) reduced loss of labor hours due to sickness, like "sore-eyes", which is related to the skin and eye contact of sulfide gases in the spinning hall.

Assuming that the production of yarn waste can be reduced by about 20%, it is estimated that Svilosa Company can save approximately \$50,000 per year in operating costs, plus additional savings in labor costs due to reduced incidence of workers' sickness.

For further details of the project, refer to the enclosed Envirometric Systems, Inc. report.

III. ENVIROMETRIC SYSTEMS, INC. REPORT

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Interim Report # 1 Waste Minimization Demonstration Project at SVILOSA Company, Svishtov, Bulgaria

INTRODUCTION

The World Environment Center (WEC), under a cooperative agreement with the United States Agency for International Development (USAID) to provide U.S. private sector expertise to transfer technology and skills to the representatives of industry and government in the countries of Central and Eastern Europe, has selected SVILOSA Company in Svishtov, Bulgaria (a major producer of rayon yarn) as a potential candidate for demonstrating the concepts of waste minimization and pollution prevention. This interim report describes the findings of a reconnaissance visit which was made during October 1993 to identify a process line at this plant suitable for conducting a Waste Minimization Demonstration Project (WMDP). This report includes a description of the project team which visited SVILOSA Company, details of the reconnaissance visit which took place in October 1993, an assessment of the waste minimization opportunities which were examined, and a proposal for the WMDP to be conducted at the plant.

WEC will review this report to determine if the objectives of their cooperative agreement with USAID will be met by the proposed WMDP. A Memorandum of Understanding (MOU) will then be prepared between WEC and SVILOSA Company to design and implement the WMDP, including training of personnel, which will also assure the commitment of plant management to continue with a specific program of waste minimization. WEC will purchase the suitable equipment manufactured in the United States for monitoring environmental quality, and provide the services of U.S. consultants to design and implement the WMDP. The MOU will also identify the plant personnel or departments that will comprise a Waste Minimization Committee and a Coordination Committee for implementing the WMDP, reviewing its benefits, developing a future waste minimization program, and disseminating this information to other companies in the region.

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PROJECT TEAM

WEC's project team which visited SVILOSA Company during October 1993 included three (3) personnel : Dr Bohdan T. Aftanas, Daniel J. Chellaraj and Raghu K. Raghavan.

Dr. Bohdan T. Aftanas, Project Manager, Technical Programs in WEC was in charge of the reconnaissance team which visited SVILOSA Company. He is qualified in Sanitary Engineering and has over 35 years of work experience as an environmental consultant in the United States and abroad. He is also involved in the development of other WMDPs under the same program of WEC.

Mr. Daniel J. Chellaraj was the pro-hono process specialist in the reconnaissance team which visited SVILOSA Company. He is qualified in Chemistry and Chemical Engineering, and has over 40 years of work experience in manufacture of chemicals and environmental quality management, including the plant design and manufacture of rayon for several years. He has also assessed and advised steps to abate pollution from chemical manufacturing operations in other countries of Eastern Europe and Latin America.

Envirometrics Systems, Inc. (ESI), an environmental consulting firm with which WEC has contracted to assist in demonstrating waste minimization, was represented in the reconnaissance team visiting SVILOSA Company by Mr. Raghu K. Raghavan. He is qualified in Chemical and Mechanical Engineering and has over 20 years of experience in industrial manufacturing and environmental consulting. He has completed several projects in the areas of pollution prevention and waste minimization both in the United States and abroad. His work in the United States has included the tracking of waste minimization progress being achieved in specific industrial facilities in New Jersey, New York and Pennsylvania. His work abroad has involved the assessment of environmental projects to control industrial and urban pollution in the countries of Asia, Africa and Eastern Europe.

RECONNAISSANCE VISIT

The reconnaissance visit to SVILOSA Company started on Monday, October 18, 1993 with a meeting with plant management to describe the goals of WEC's program, define the information needs of the WEC's project team during the visit, obtain basic information on the process for manufacture of rayon being used at the plant, and understand the environmental and operational priorities of the company.

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The first meeting of the visit was attended by :

- Dipl. Eng. Michail Koltchev
Deputy General Director
Production Division (SVILOSA Company)
- Dipl. Eng. Velitchko Kounev
Manager of the Rayon Mill (SVILOSA Company)
- Dipl. Eng. Rumen Vitkov
Manager Research and Development Dept. (SVILOSA Company)
- WEC's Project Team
(Dr. Aftanas, Mr. Chellaraj, and Mr. Raghavan)

This group met again on the last day of the the reconnaissance visit - Thursday, October 21, 1993 - to discuss WEC's proposal for conducting a WMDP in the spinning hall of the Viscose Rayon Manufacturing Plant in SVILOSA Company. Before submitting its proposal, WEC's Project Team completed a detailed review of the plant and process for rayon manufacturing in SVILOSA Company, including meetings and discussions with various plant personnel to explore the opportunities available for conducting a WMDP.

BACKGROUND INFORMATION

The SVILOSA Company started operations in Svishtov, located south of the Danube River which is also a border of Bulgaria with Romania, in 1966 with construction of an industrial complex spread over an area of 13,000 acres to manufacture pulp for paper, rayon filament, air processing instruments, miscellaneous chemical processing equipment and electricity based on coal as the fuel. The original complex included plants for manufacturing both rayon staple fibers and rayon yarn. At present, only the rayon yarn mill is in operation. SVILOSA Company's current employment is reported to be 3,500.

SVILOSA Company uses conventional process lines to manufacture approximately 5,000 metric tons per year of textile-grade rayon yarn of different customer specifications for appearance, color and strength of the yarn. The SVILOSA Company is also the only plant for manufacturing rayon in Bulgaria and most of the high quality rayon produced at this plant (estimated to have prices ranging from \$ 1.36 to \$ 1.80 per pound in the local market) is targeted for export. The plant is also known to have been operated with high utilization of production capacity from the date of its actual start-up in 1976.

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The main raw material for manufacturing rayon - alpha cellulose - is imported from Russia and Germany with other raw materials (including sodium hydroxide, sulfuric acid, carbon di-sulfide and zinc sulfate) being supplied by local manufacturers. The plant is of Russian design with most of the equipment imported from Switzerland. Until 1987, when a major fire stopped plant operations, SVILOSA Company also manufactured approximately 40,000 metric tons per year of staple fibers of rayon at a plant located near the existing rayon yarn mill.

Based upon the information provided by SVILOSA Company, two (2) major environmental problems were identified in the rayon manufacturing process:

- (1) air pollution due to the emission of carbon di-sulfide and hydrogen sulfide; and
- (2) water pollution due to the discharge of wastewater containing zinc.

At present, however, the plant is not being charged any penalties for air or water pollution.

The air pollution was being controlled better in the past when the rayon staple fiber was also produced in SVILOSA Company. At that time, it was found economically feasible to recover and recycle the carbon di-sulfide emitted by both rayon manufacturing plants through operation of an activated carbon adsorption system. Hydrogen sulfide was also treated in another unit of the same air pollution control system. This system is however not in use at present as it is too large for recovering gases emitted by only the rayon yarn mill. At present, the gases emitted in the spinning hall and the after-treatment section of the rayon mill are collected by exhaust fans and discharged through a stack into the air.

The water pollution from zinc contamination was being controlled in the past by SVILOSA Company primarily through dilution and neutralization of the wastewater streams collected from the spinning hall of the rayon mill which are then discharged to the Danube River. However, SVILOSA Company has been able in the recent past to recover and reuse zinc by segregating and treating wastewater containing zinc sulfate used in rayon yarn manufacturing with sodium hydroxide and diverting the precipitates to the pulp mill nearby.

The detailed review of the plant and process for rayon manufacturing in SVILOSA Company, which was conducted by WEC's Project Team during the reconnaissance visit, also showed that waste generation and management at the plant has been efficient in general. For example, alkali cellulose manufacturing at the plant had no waste streams as the excess caustic liquid from the seeping press operations is recycled to the pulp mill. The

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shredding and aging operations in this process line were also not found to be associated with any visible generation of waste from material spillages or material handling problems. Viscose manufacturing at the plant also had no apparent waste generation or off-spec production during the step of xanthation of alkali cellulose or during filtration of the viscose solution. Spinning of rayon yarn was also found to be operated efficiently with provisions being made for recovery of sodium sulfate generated as a by-product in the process and use of alternative raw materials such as sodium bi-sulfite instead of sodium sulfide.

Therefore, the operating problems facing the plant at the time of WEC's reconnaissance visit appeared to be predominantly limited to air pollution by the sulfide gases released during spinning of rayon yarn, and water pollution by zinc sulfate during the production of rayon yarn. The other developmental projects being studied by SVILOSA Company are related to modernization of plant equipment for : filtration of viscose; evaporation of the spin-bath overflow; degassing the spin-bath; and continuous operations instead of the existing conventional process line for spinning the yarn. While these projects are expected to improve upon both the economy and environmental impact of operations at the plant, it is generally recognized that these projects are essentially capital-intensive and were being investigated by SVILOSA Company only for implementation in the long term.

WASTE MINIMIZATION OPPORTUNITIES

WEC's project team examined the following opportunities existing in the rayon yarn mill of SVILOSA Company before developing a proposal for the WMDP.

The technically feasible options for improving operations and reducing pollution from rayon yarn manufacturing in SVILOSA Company included :

- (1) recovery and recycling of the carbon di-sulfide gas released in the spinning hall, along with a possible treatment of hydrogen sulfide gas generated from the same source with sodium hydroxide to manufacture sodium sulfide which can be used in the post-treatment of rayon yarn; and
- (2) physical and chemical treatment of segregated wastewater streams from the plant to precipitate and recycle zinc sulfate in the process.

Both waste minimization opportunities are recognized as economically beneficial in the United States where special studies have been completed during the last decade to identify process alternatives to achieve each of these waste minimization options. The final report of WMDP to be conducted by WEC will address these alternatives in greater detail.

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However, the reconnaissance visit of WEC has shown that process alternatives for recovery and recycling of raw materials, such as carbon di-sulfide or zinc sulfate, will be either highly capital-intensive or too skills-oriented solutions to be considered for implementation during the WMDP itself. It is also noted that adequate regulatory driving force does not exist in the region where SVILOSA Company is located to promote an immediate control of air or water pollution. Moreover, as SVILOSA Company has recently developed an economically feasible alternative to reuse zinc from rayon manufacturing wastewater in the pulp mill, it was concluded that the WMDP should :

- focus upon air pollution; and
- improve environmental conditions in the spinning hall as a step towards better collection and ultimate recycling of the noxious gases.

Detailed review and discussion of operating conditions in the rayon manufacturing plant in SVILOSA Company have indicated that it is possible to achieve these goals, as well as economic benefits, by designing and conducting a suitable WMDP. The spinning hall and the section for after-treatment of rayon yarn are provided with an extensive area ventilation and local exhaust system to replace approximately 925,000 cubic meters of air per hour. Out of the total quantity of air which is exhausted, approximately 50,000 cubic meters are exhausted directly from the spinning machines where carbon di-sulfide and hydrogen sulfide are emitted during the extrusion of viscose in an acidic spin-bath to manufacture rayon yarn. Some provisions have also been made at the plant to increase the air exhaust rates from the machine during the periods of time when the spinning machines are opened to remove the rayon "cake" after it reaches a certain size and to start a new cycle of rayon yarn spinning in the machine. It is believed that gases are released from the machine into the working area of the spinning hall primarily during the times when the machine shutters are opened between cycles of operation. Additional local exhaust systems have also been provided outside the machine to continuously exhaust residual gases from the rayon cakes as they are transported for further treatment and processing in the plant. The spinning hall has also been provided with forced circulation of air to achieve a minimal number of air changes and maintain room humidity. Despite all these provisions for air conditioning and ventilation, it is noted that the concentration of contaminant gases in the working area vary widely from place to place and is typically more than the concentrations observed in similar plants in the United States which have developed suitable operating practices to control the release of noxious gases during spinning operations.

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For example, the concentration of carbon di-sulfide varies from 10 to 50 milligrams per cubic meter at this plant, whereas the regulatory standards in the United States require this concentration to be maintained below 10 parts per million (PPM) inside rayon mills.

The WEC Project Team concluded that the working conditions in the spinning hall of the rayon yarn mill can be improved after completing detailed meetings with plant personnel most familiar with the problem in SVILOSA Company. During these meetings, the personnel responsible for maintaining air conditioning and ventilation in the spinning hall reported that they will be able to obtain better results even from the existing system if they were to receive a timely feedback from the laboratory technicians conducting measurements of the concentration of carbon di-sulfide and hydrogen sulfide in the working area near the spinning machines. It was also noted during a separate visit made by the WEC Project Team to examine the operation of air ventilation system in the spinning hall that air dampers in some of the ductings for exhausting the area were incorrectly set (open or closed) which can prevent optimal performance of the system. It appears that an improvement in the situation is possible by developing and implementing appropriate best management practices (BMPs) to limit the release of contaminant gases from the machine. This project will also benefit from a suitable baseline to characterize better the variation of air quality in the spinning hall at different locations and times of operation. For this purpose, better procedures for monitoring the air quality must be implemented.

The WEC Project Team has also concluded after meeting with plant personnel that improving working conditions in the spinning hall will have the following financial benefits:

- (1) reduced production of waste yarn at the plant due to increased presence of operators in the area and better attention being given to the spinning operations;
and
- (2) reduced loss of labor hours due to sickness, like "sore-eyes", which is related to the skin and eye contact of sulfide gases in the spinning hall.

Even by assuming that the production of yarn waste can be reduced by 10 to 20 %, it is estimated that SVILOSA Company will save approximately \$25,000 to \$50,000 per year in operating costs. Additional savings in labor costs due to lesser sickness can be estimated after receiving more specific information from the plant's medical care personnel.

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WASTE MINIMIZATION DEMONSTRATION PROJECT

The WEC Project Team has proposed to SVILOSA Company that a project be developed and implemented to demonstrate that a reduction of noxious gases can be achieved in the spinning hall of the viscose rayon manufacturing plant. This WMDP is also expected to result in production of less waste and improvements in health and safety of workers in SVILOSA Company. In order to develop a baseline, as well as to measure the improvement of air quality in the spinning hall, WEC will provide air monitoring equipment for the project. It is expected that a purchase order for this equipment will be placed during December 1993.

The first phase of the WMDP will include the following steps :

- Set up the air quality monitoring equipment;
- Train plant personnel in using new air monitoring equipment;
- Select an area within the spinning hall for WMDP
- Install additional air flow monitoring equipment and procedures;
- Establish the baseline of environmental conditions in the area;
- Adjust operating conditions for air condition and ventilation of the area and observe effects on air quality from these changes;
- Investigate other alternatives for improving ventilation; and

It is expected that the first phase of the WMDP will be completed during February 1994.

A Waste Minimization Committee, consisting of plant personnel, will then implement the second phase of the WMDP, including continuous monitoring of air quality, appropriate modification of the project as required and reporting the findings of the project. It is expected that the second phase of the WMDP will be completed during April 1994. Representatives of WEC's Project Team will visit SVILOSA Company and participate in commencing the first phase of the WMDP (January or February 1994) as well as to review the results of the project at the end of second phase of the WMDP (March or April 1994). The third and final phase of the WMDP will involve a Coordination Committee of the project developing a long term plan for continuing waste minimization, including a review of alternatives for process alternatives for recovery and recycling of gaseous contaminants exhausted from rayon manufacturing plant in SVILOSA Company and dissemination of the benefits of waste minimization to other industries in the region. It is expected that the third phase of the WMDP will be completed by June 30, 1994.

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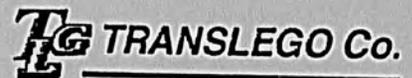


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