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TRIP REPORT #1 PERION AKKUMULATORGYAR RT.

BUDAPEST, HUNGARY

WASTE MINIMIZATION PROJECT

AUGUST 2 - 6, 1993

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

DECEMBER 1993

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File

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I. INTRODUCTION

Pursuant to the technical assistance program for Central and Eastern European countries funded by the U.S. Agency for International Development, the World Environment Center (WEC) team conducted a reconnaissance visit to Perion Akkumulatorgyar in Budapest, Hungary on August 2 - 6, 1993.

The purpose of the visit was to establish the feasibility of a Waste Minimization Demonstration Project (WMDP) and to select the subject for such project.

II. EXECUTIVE SUMMARY

WEC's team consisting of Ms. Zsuzsanna Dorko, in-country coordinator, Mr. Daniel Askin, President, Esca Tech, Inc., and Dr. Raymond L. Feder, WEC consultant, made a reconnaissance trip to Perion Akkumulatorgyar RT. - Battery Plant in Budapest. The purpose of the visit was to establish the feasibility of a Waste Minimization Demonstration Project and to select process facilities for such project. From August 2 through 5, 1993, WEC's team held a number of meetings with plant management and made a detailed review of the process to explore the opportunities available for conducting a WMDP. Plant management indicated great interest in such project which was reflected, among other things, by their outstanding cooperation with WEC's team.

Following discussions and mutual consultations, it was concluded that the WMDP is feasible. The project will focus on reduction of quantities of water usage, including decrease of wastewater flow and lead and cadmium quantities discharged into the municipal sewer system. It is anticipated that implementation of the project can yield savings up to $65,000 per year. In addition, the project will prevent about 220 kg/year of lead and about 60 kg/year of cadmium from entering the environment.

For further details of the WMDP, refer to enclosed Esca Tech, Inc. report.

On August 6, 1993, the WEC's team met with the U.S. AID Mission representatives to brief them on the results of the visit to Perion Akkumulatorgyar RT.

III. ESCA TECH, INC. REPORT

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4860 North Hopkins Street
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November 29, 1993

Mr. Thomas J. McGrath
Vice President - Technical Programs
World Environment Center
419 Park Avenue South
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RE: Perion Akkumulatorgyar Waste Minimization Project
Visit to Budapest, Hungary; August 2 - 5, 1993

Dear Mr. McGrath:

Following is a summary of our observations and recommendations from the trip to the Lead Acid Battery Manufacturing Facility at Perion Akkumulatorgyar, in Budapest, Hungary. The purpose of this letter is to document these observations and to define the scope of work for the remainder of the Waste Minimization Project at Perion.

BACKGROUND

Perion is the largest producer of lead acid batteries in Hungary. They employ 650 people nationwide, with 500 at the Budapest manufacturing facility. The World Environment Center (WEC) has a cooperative Agreement with the US Agency for International Development (US AID) to provide U.S. private sector expertise to transfer technology and skills to Central and Eastern European industry and government representatives. The purposes of the WEC Project would be:

* more effective pollution reduction
* improved use of natural resources
* improved industrial health and safety practices
* improved energy conservation and management
* increased community awareness in environmental and energy related areas
* provide instruction in the waste minimization process for dissemination throughout Hungary's manufacturing sector

An initial visit was conducted at the facility from August 2 - 5, 1993. The WEC team included Dr. Raymond L. Feder, WEC Consultant, Mr. Daniel P. Askin, of ESCA Tech, Inc.; a specialist in industrial hygiene and environmental engineering controls for processors of lead, arsenic, nickel and cadmium and Ms. Zsuzsanna Dorko, WEC Coordinator for Hungarian Technical Programs.

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A potential Waste Minimization Demonstration Project (WMDP) was identified during the site visit. This is:

Water Use Reduction & Lead Discharge Abatement

The specific objectives which have been identified by this visit are:

1. Reduce fresh water consumption at the plant by at least 25 %, in the first year or 47,000 cubic meters per year (m3/yr).

2. Improve wastewater discharge quality, first by determining that the most contaminated waters are properly pretreated and second, by removing more contaminants in wastewater pretreatment.

3. Reduce wastewater pretreatment costs.

4. Reduce the frequency of confined space entry by personnel to clean the three treated wastewater tanks. At present each tank must be cleaned twice per week.

5. Review the concepts and benefits of process water conservation and waste minimization.

6. Reduce or eliminate penalties for excess wastewater discharge to the municipal sewers.

PARTICIPANTS at PERION in WASTE MINIMIZATION COMMITTEE MEETINGS

Dr. Jozsef Keri	General Manager
Agnes Horvath	Chemical Engineer, Leader of International Group
Sandor Kovacs	Engineer, Energy & Water Systems
Jozsef Ipacs	Process Engineer, Water Systems

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OVERVIEW OF PERION

The Perion complex is located on the north side of Budapest, and covers an area of approximately 2 city blocks. The plant produces lead acid batteries for starting, lighting, ignition, stand by power, railroad and motive power applications. At the same site, they also manufacture nickel cadmium batteries for rail car lighting and dry cell batteries. Dry cell batteries contain primarily carbon, manganese dioxide, iron and a trace of mercury chloride.

The plant site was originally outside of the city. Over the years Budapest has enveloped the plant and it now has a hospital, a school, other factories, government offices and residences surrounding it.

Perion is under transition to a private company to be owned by the state, banks and employees. Regulations and market forces have forced them to adopt the following priorities:

A. Environmental Health & Safety

1. Reduce wastewater discharges to the municipal sewer system

2. Reduce fugitive emissions & improve ambient air quality in neighborhood

3. Reduce worker exposures and improve safety

B. Quality Assurance

C. Worker Productivity

Of these items, A1 (wastewater) and A2 (ambient lead in air) have the potential to cause the factory to close and force relocation outside of Budapest. The ambient lead in air problem is less critical to the plant since 90 % of the ambient lead in the plant neighborhood is from lead in gasoline car emissions.

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REGULATORY SETTING

The fee structure for fresh water use and wastewater discharge is different from the US fee structure.

1. **Water Use Charges:**

   The plant receives fresh water from both the city water supply system and from wells located on the property. The plant pays 39 HUF (Hungarian Forints) for each cubic meter consumed. This fee also includes standard sewer charges. Excess fresh water use penalties occur at usage levels above 30,000 m3/month. The plant currently uses fresh water at the rate of about 15,000 m3/month.

2. **Contaminant Levels in Wastewater Discharges:**

   We have estimated the following totals from the plant's data averages for 1992. See Figure # 1.

Contaminant:	Measured Level	Limit (ppm)	Total Discharge Kg/year:
Lead (ppm):	2.6	0.2	435
Cadmium (ppm):	0.07	0.02	117
Sulfate (ppm):	865	400	145,000

3. **Historical Water Use & Wastewater Discharge Penalties:**

   In 1991, the plant used more than 200,000 m3 of fresh water. They were charged an additional 10,000,000 HUF in wastewater discharge penalties. (This is under appeal).

   In 1992, the plant used 184,000 m3 of fresh water and discharged 168,000 m3, and paid a wastewater discharge penalty of 1,000,000 HUF.

   In 1994, with the implementation of the proposed WMDP, they expect to reduce fresh water consumption to 137,000 m3 and discharge of wastewater to 120,000 m3. At this reduced wastewater volume, the plant still expects a penalty to be assessed.

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FIGURE # 1

PERION WATER SYSTEM - ESTIMATED DISCHARGES for 1992

WASTEWATER DISCHARGE ESTIMATE IS 167,500 m3/YEAR

Estimated Discharges:			Allowable Discharges:	
LEAD:			LEAD:	
	2.6	mg/l		.2 mg/l
	436	kg/yr		34 kg/yr
CADMIUM:			CADMIUM:	
	.7	mg/l		.2 mg/l
	117	kg/yr		34 kg/yr
SULFATES:			SULFATES:	
	865	mg/l		400 mg/l
	144,888	kg/yr		67,000 kg/yr

There are two potential penalty levels. They would be pay a smaller penalty if they reduce the concentration of contaminants in their discharge then they will pay if they only reduce their consumption. The largest benefits occur if they do both.

(a) With improvement in the discharge wastewater quality, a fine of 700,000 HUF would be imposed (plant estimate).

(b) If the discharge wastewater quality does not improve, regardless of any water use reduction, a progressive penalty 5 times higher will be applied. The fine would then be: 3,500,000 HUF (plant estimate).

3. **Basis of regulatory measurements:**

The authorities use total fresh water supply, not total wastewater discharge volume to calculate penalties. At Perion, 10 % of the fresh water supply is used by production and shipped out in the finished products. Grab samples are collected from the sewer manhole 8 or 10 times per year. Discharge penalties are calculated by multiplying the supply volume by the total excess concentration of the contaminants in the grab samples. Current discharge estimates and allowable discharges are provided in Figure # 1.

DISCUSSION

Several improvements need to occur simultaneously to achieve the maximum benefits from implementation of this project.

First, a quantitative mass balance must be determined. The incoming city water supply is metered. The water volumes used in each department, as well as total discharge volume is estimated. The first step for the plant will be to determine the actual mass balance of water use and contaminant levels.

Figure # 2 is a schematic flow diagram of water use and contaminant concentrations based on estimates provided by the plant.

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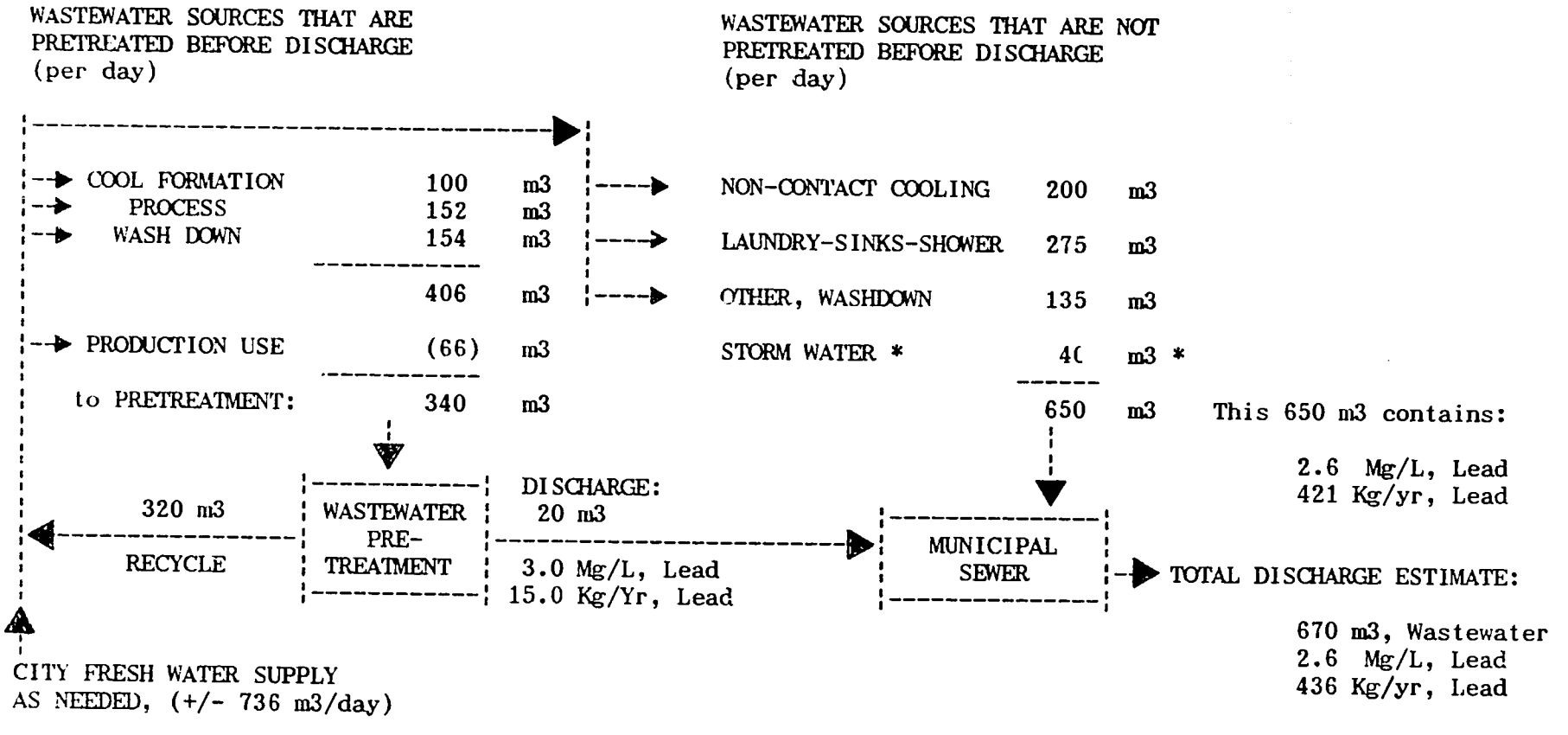
FIGURE # 2

PERION WATER SYSTEM - ESTIMATED MASS BALANCE for 1992

WATER SUPPLY:	184,000 m3/year
PRODUCTION USE (Shipped in product):	(16,500)m3/year
	167,500 m3/year



* The average annual stormwater flow of 10,000 m3/year was divided by 250 workdays of plant operation to arrive at the average daily load of 40 m3, and to balance the water flow rates.

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DISCUSSION, continued

Second, after the mass balance is completed, the plant should review which wastewater streams need to be pretreated. Based on my review of their data estimates, it appears that 96 % of the lead in their wastewater discharge is contained in other wastewater flows that are not pretreated.

Third, the wastewater pretreatment system process needs to be optimized. Figure # 3 is a schematic flow diagram of the existing pretreatment process at the plant.

The wastewater pretreatment plant was originally designed for an average flow rate of 16 m3 per hour and to meet a discharge level for lead of 5 parts per million. At 1992 wastewater discharge levels, the plant needed a system capacity of 28 m3 per hour. It is not technically feasible to meet the current discharge limits of 0.2 ppm for lead at existing flow rates with this system. Thus, plant water use should be reduced.

Over the last few years they have improved the discharge levels achievable for lead from 5 ppm to 2.6 ppm. They still need to improve further to 0.2 ppm. Regulations require they improve their discharge levels this year. They will be provided a longer time frame to meet the final limits.

Finally, Perion needs to improve their discharge monitoring capability. The current grab sampling techniques do not provide the plant with accurate measurements of their actual discharges. This is valuable system control information for the wastewater system operators.

RECOMMENDATIONS **Part A:** **Existing Mass Balance:**

First, an existing mass balance needs to be determined by the plant.

1. **Verify the existing water supply use locations and patterns:**

   The plant currently estimates water use without definitive measurements. Each water use point (for both fresh and recycled treated wastewater) needs to be measured. This information will tell the plant where too much water is used, and where it can be reduced.

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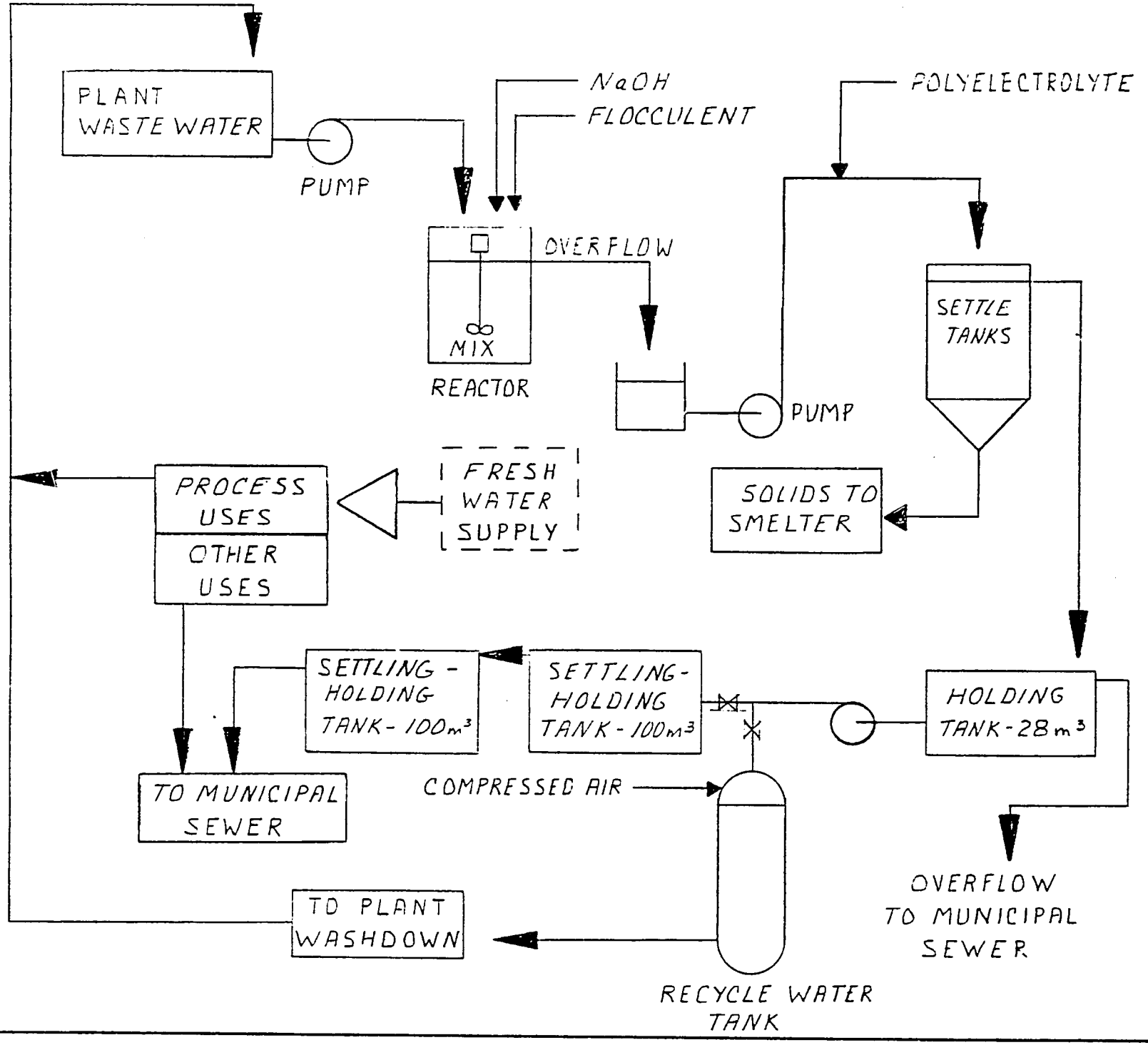

FIGURE #3

CUSTOMER	
SUBJECT	WASTEWATER PRETREATMENT SCHEMATIC FLOW DIAGRAM
JOB NO.	
BY	DPA
DATE	11-30-93

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Equipment required: Two in-line flow meters that can be moved around the plant to meter the volume of water used in each process and department. Both fresh and recirculated water needs to be measured, along with the cooling water flows and cooling water temperatures.

2. **Determine the actual wastewater volume and the level of contaminants in each wastewater stream.**

   At present the plant estimates the water flow and combines this information with grab sample measurements of contaminants from each wastewater source in deciding which streams need to be treated. Upon reviewing the figures provided, it appears they have underestimated the quantity of contaminants in some streams since, an estimated 96 % of the lead discharged to the municipal sewers is contained in wastewater that is not pretreated, according to our understanding of the plant data.

   Equipment required: Two portable, automatic wastewater samplers that can be moved to each wastewater source (for example: wash down, laundry, sinks, showers and stormwater), so the wastewater contaminant levels can be determined and combined with the flow information to characterize each wastewater source.

   The second sampler (with an integral flowmeter) is needed to collect simultaneous samples at the wastewater pretreatment system discharge.

3. **Map the existing wastewater piping and drainage system:**

   The plant was built in 1905, and what is believed to be the drainage and piping systems may not accurate. The actual, existing, pipe connections need to be verified with dye mapping by plant personnel.

   Equipment required: Fluorescent dyes to map the piping and drainage systems.

The above items will allow informed decisions to be made concerning water conservation, and which flow streams must be treated, and which do not require pretreatment.

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Part B: **Optimize wastewater pretreatment process and improve control**

Improved process control, combined with reduced flow and control of peak flows will result in lower discharge levels. Each small improvement in treated wastewater quality will result in additional uses for recycled water, further reducing wastewater volume.

In the wastewater pretreatment process, excess acid is neutralized with sodium hydroxide. Then the metals are precipitated as hydroxides. The metal hydroxides are removed in a settling chamber. Best results occur when the flow rate is constant and three variables are controlled.

1. **Accurate pH control.** The minimum solubility of lead and cadmium occur over a very narrow range of pH. The pH of the wastewater feed can vary from 0 to 14, depending on which waste streams are arriving at the pretreatment plant at any time.

   Equipment required: pH measurement, control and recording system. The plant will provide this equipment. Optimum control of this variable will also require periodic use of one of the automatic wastewater samplers and a flowmeter.

2. **Accurate flocculent feed rate.** The flocculent feed rate must be accurately tied to wastewater flow rate and volume. The wrong amount prevents the metal hydroxides from forming particles.

   Equipment required: Doppler (ultrasonic) flowmeter to measure the flow of wastewater to the pretreatment system. This wastewater stream contains high solids and has a pH range of 0 to 14. Control of this variable will also require occasional use of one of the automatic samplers.

3. **Adequate settling time.** After the metal hydroxides are formed, the polyelectrolyte is added to cause them to form large particles. The wastewater needs sufficient time in the settling tank for the metal hydroxides to settle. The settling time available in the tanks is a function of flow rate. The occurrence of peak flows upsets the settling system and results in metals getting through. Flow rate measurements will help identify where the wastewater originates when these peak flows occur. Once these sources are identified, schedule changes can shift some of the peak flows to other times.

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Equipment required: Uses the same flowmeter as item # 2 above on a rotating basis. Determining the best feed rate for the polyelectrolyte will also require use of an automatic sampler.

BENEFITS

Case # 1: Water use reduction, no improvement in discharge wastewater quality.

These figures are based on reducing fresh water usage by 47,000 cubic meters per year.

1. Decreased fresh water use; reduces water use fees:

   47,000 m3 * 39 HUF/m3 = 1,833,000 HUF

2. This reduces discharge penalties

   137,000 m3 * 5.11 HUF/m3 = 700,000 HUF

3. This reduces the cost of chemicals & energy used to treat the wastewater

   47,000 m3 * 14 HUF/m3 = 658,000 HUF

   Total estimated savings: 3,191,000 HUF

   US $34,300.00

4. The quantity of lead, cadmium and sulfates in the wastewater discharge is reduced because there would be less wastewater to be processed, and the system will operate more efficiently.

   Lead reduced by half: 61 kg/yr

   (47,000 m3 * (2.6 g/m3 * 50 %)/1000 g/kg

   The reduction of cadmium and sulfate levels cannot be estimated with the data currently available.

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BENEFITS, continued:

Case # 2: Water use reduction, 50 % improvement in discharge wastewater quality for metals.

Estimates are based on 47,000 cubic meters per year fresh water use reduction.

1. Reduced fresh water use reduces water use fees

   47,000 m3 * 39 HUF = 1,833,000 HUF

2. Reduced discharge penalties

   137,000 m3 x 5.11 HUF/m3 * 5 = 3,500,000 HUF

   (There is a penalty multiplier of 5 applied when discharge wastewater quality does not improve).

3. This reduces the cost of chemicals & energy used to treat the wastewater

   47,000 m3 x 14 HUF/m3 = 658,000 HUF

   Total estimated savings: 5,991,000 HUF

   US $64,500.00

4. The quantity of lead, cadmium and sulfates in the wastewater discharge is reduced because there is less wastewater discharged, and because of improved wastewater discharge quality. (Reduction is calculated on the basis of a 50 % reduction of metals in discharged wastewater).

   Lead reduced by: 61 kg from flow reduction +

   $$\frac{(167{,}500 - 47{,}000)\ m3 * (2.6 * 50\ \%)\ g/m3}{1000\ g/kg}$$

   = 157 kg/yr + 61 kg/yr: 218 kg/yr

   Cadmium reduced by 50 %: 59 kg/yr

   Sulfate reduction cannot be estimated with the data currently available.

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EQUIPMENT REQUIRED for WMDP:

1. Florescent dyes to map wastewater flows and to verify the actual piping connections.

   $600.00

2. Two (2) In-line flowmeters to measure fresh water flows. They will be used to determine the water use mass balance and to measure cooling water flows so closed loop cooling water systems can be sized and purchased locally.

   $2,200.00

3. Two (2) portable automatic wastewater samplers to collect composite samples of flows. Samplers can be quickly relocated to collect samples at every point of wastewater generation and wastewater pretreatment. One (1) includes the flowmeter option for measuring flows, the second does not require a flowmeter. Two automatic samplers allow simultaneous collection of samples at different points for data analysis and comparison.

   $12,600.00

4. Portable, doppler (ultrasonic) flowmeter to measure wastewater flows into the reactors and the settling tanks, to control the addition of pretreatment chemicals determine the optimum chemical feed rates. Portable feature is recommended so it can be used to conduct studies at other parts of the wastewater system.

   $8,400.00

Budget: **$23,800.00**

TRAINING REQUIRED

Two (2) weeks of Mr. Askin's time in Hungary is expected to set up the sampling strategy to determine the mass balance, train personnel in the installation of the equipment, use of florescent dyes for locating wastewater system leaks and to instruct personnel in programming and calibrating the automatic samplers and flowmeters.

One (1) follow up visit of one week is expected to review the data collected and assist in data interpretation; and one (1) final visit to compile the economic benefits actually realized.

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RECOMMENDATIONS & SUMMARY

A total of three (3) more trips to Hungary are expected. The next trip will include follow up on techniques and implementation of water conservation techniques already provided and to supervise installation of monitoring equipment.

The second trip would be used to review the data collected and assist with interpretation and recommended modifications to the systems. A third trip is to estimate the benefits of the completed projects.

Interim field reports, (three are anticipated) and a final summary report will be submitted to WEC. We expect to complete our involvement by July 30, 1994.

We look forward to continuing this project. Please feel free to give me a call with any questions.

Sincerely,
ESCA Tech, Inc.

Daniel P. Askin
President

Attachment: Six pages from Perion Akkumulatorgyar RT

IV. ITINERARY

o	August 1, 1993	-	Arrival in Budapest
o	August 2 - 5, 1993	-	Meetings with the Perion Management and tour of the facilities
o	August 6, 1993	-	Debriefing of U.S. AID Representative in Budapest
o	August 7, 1993	-	Departure from Budapest to U.S.

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V. BUSINESS CARDS OF CONTACTS

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Founded in 1893

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