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Environmental Pollution
Prevention Project

A Report of the
Office of Environment and Natural Resources
Bureau for Global Programs
United States Agency for International Development

POLLUTION PREVENTION OPPORTUNITIES PROFILES SANTIAGO, CHILE

Final Report

Prepared for:

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The pollution prevention audit/assessment reported on herein was conducted by a team of EP3 and industry representatives. The primary purpose was to assist industry or facility management in creating a sustainable pollution prevention and waste minimization program. This report presents information from the first step in the process; a base line survey and a definition of actions which can be taken to prevent pollution, improve efficiency and pay back any required investments.

The overall EP3 program in the countries in which EP3 has activities includes a wide range of activities including audits/assessments, information dissemination, training and small scale demonstrations. These country programs are all designed to create the conditions in the country which will assure the continuation of urban and industrial pollution prevention and establish locally sustainable pollution prevention programs.

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VISIT REPORT: William Bilkovich

INDUSTRY VISITED: METALURGICA MORGAN Y FUENZALIDA
SANTIAGO, CHILE

INDIVIDUALS MET: Nelson Ubilla Toledo, Public Relations Director
Gerardo Bravo P., Manager of Galvanizing

EP3 TEAM: William Bilkovich, Eduardo S. Maal, Maurice Knight, Jorge Castillo

Date of Visit: March 18, 1994

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Morgan fabricates large metal structures, machines metal parts and hot-dip galvanizes customer parts and some of its own production. The plant is divided into fabrication and machining and hot-dip sections. Only the hot-dip process was discussed and viewed. The manager of machining was not available. The team was told that not much machining was done. Waste coolants are apparently dumped directly to the sewer. The galvanizing operation employs 35 workers on two shifts. During the last four months, 2,400 metric tons of steel were hot-dipped. Zinc purchases are approximately 10-15% of final product weight. The standard short visit questionnaire was given to Mr. Ubilla during the visit.

OBSERVATIONS: The hot-dip area is under an open-sided shed roof on a dirt floor. Four rectangular 6-7000 liter fiberglass-covered steel tanks are used for pickling with Hcl (three tanks), rinsing (one tank) and fluxing (one tank of 60/40 ammonium chloride/zinc chloride) of parts. Two of the acid tanks and the rinse tank are set over a sump. One acid tank and the flux tank are set directly on the dirt floor. Smaller parts are pickled, fluxed and rinsed in much smaller tanks set on the floor. A drain rack holds parts waiting for zinc-dipping. The drainage from that rack drips onto the floor. Large parts (assumed to be most of the plant's production) are hot dipped in a rectangular tank of about 7,000 liter capacity. Small parts are hot-dipped in a much smaller tank. The two zinc hot-dip tanks are heated with bottled gas as is a drying oven that was not operating during the visit. Spent hydrochloric acid, water dumped from the rinse tank and spent flux are normally sent to a tank for neutralization with lime. After neutralization, liquids are discharged to the sewer. Sludge from the tank is taken off-site by Disal. The cost of disposal and the ultimate fate of the sludge were not determined.

The neutralization tank has recently been removed and a new tank is under construction. Until that project is completed no tanks will be dumped. Dragout that is falling to the sump is being accumulated there until the neutralization tank is ready. Mr. Bravo believes that their only problem is fine-tuning the neutralization process. Mr. Bravo stated that rework is 0.4% of production. Product quality was poor with many spots where bare metal would be exposed as soon as the non-adherent lump of zinc fell off. Product quality observed might not be typical because of the changes necessitated by the lack of a neutralizing tank. For example, some parts were not being fluxed during the visit so as to extend the life of the flux bath. Zinc spatter is recovered for recycling.

Sewer effluent has been tested for pH, but not for zinc, cadmium, arsenic or any other parameter. The Secretary of Sanitary Services has not yet requested that Morgan's effluent be tested.

POLLUTION PREVENTION OPPORTUNITIES:

1. Dragout Reduction

   Dragout from acid and flux tanks could be reduced by holding parts above the tanks for one minute. This would not affect product flow appreciably. The team observed parts being rapidly withdrawn from the acid tank and put into the rinse tank while still actively dripping acid. The acid tank that had been vacated was not used during the rest of the tour. Parts which had been rapidly withdrawn from the rinse tank and transported to the drain rack while still actively dripping sat on the drain rack dripping onto the dirt floor for at least 20 minutes before being galvanized. Acid and flux costs could be reduced, less lime would be needed for neutralization, and less acid and flux would be dripped into the local aquifer through the dirt floor.

2. Control of Flux Chemistry

   Mr. Bravo considers the cost of flux to be a major expense. No flux bath composition testing program is used. When parts begin to show defects related to fluxing, the bath is checked. If it has drifted too far (undefined) from ideal composition, the bath is dumped. This expensive process is out-of-control. A testing protocol would reduce releases to the environment, improve product quality and reduce costs.

3. Acid Recovery

   Pickle acids can be regenerated using a combination of ion-exchange and active membranes. Capital costs are high and operator training is crucial to prevent the destruction of expensive membranes. Paybacks in North America are in the four to seven year range depending upon the acid used, local regulation of elementary neutralization and the avoided cost of disposal. Without knowing acid and disposal costs at Morgan, a payback estimate is not possible.

Sophisticated recovery equipment and a dirt-floor operation are probably not technologically compatible.

4. Combustion Control for Zinc Heating and Part Drying

Both of these devices should have their combustion efficiency measured and adjusted. The last time the burners were adjusted was when they were installed. Reduced emissions and fuel costs would be the result.

RECOMMENDATIONS: Morgan is a suitable candidate for a standard PPDA. The PPDA would help quantify and implement the savings available from some procedural changes. These changes would reduce the use of acid, flux and lime. Mr. Bravo was given a short course in dragout reduction, told he should tune the burners on his zinc tanks and oven, and participated in a discussion of the advantages of collecting information on the composition of the flux tank more frequently. Dragout reduction will reduce the amount of contaminants leaking through the dirt floor, but only a full concrete pad would entirely protect the local aquifer.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests information on the amount and cost of yearly acid, flux and zinc purchases as well as the information requested in the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Includes a summary of any pollution prevention options that were discussed during the plant visit. This summary is attached to this report.

Within two weeks of the first letter:

1. Gather all requested information;
2. Ask Mr. Bravo if he has made any changes in dragout practices (in general ask if the options included in the thank you letter have been implemented). This will tell us if discussing easily-implemented options during short visits is useful.

SUMMARY OF P2 OPTIONS DISCUSSED DURING MORGAN VISIT:

1. Remove parts from baths much more slowly. This allows surface tension to remove more adhering liquid. Most important with viscous liquids such as flux;

2. Orient parts on racks so that the smallest amount of edge is at the bottom of the part. This reduces dragout;

3. Hold parts over tanks for one minute to recover most dragout;

4. Shake parts or tilt parts while they are still over the bath to remove dragout trapped in channels or grooves;

5. Begin a program of testing flux so that the chemistry of the bath can be adjusted before bad parts are produced;

6. Have the combustion efficiency of the zinc-bath and drying-oven burners tested and adjusted if necessary.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **METALURGICA MORGAN Y FUENZALIDA**
SANTIAGO, CHILE

INDIVIDUALS MET: **Nelson Ubilla Toledo, Public Relations Director**
Gerardo Bravo P., Manager of Galvanizing

EP3 TEAM: **William Bilkovich, Eduardo S. Maal, Maurice Knight, Jorge Castillo**

Date of Visit: **March 18, 1994**

There are two plants, one next to the other. One is an steel structures fabrication plant and the other a galvanizing plant. This last one was visited.

Liquid Wastes:

Discharge of used Hcl pickling solution (3 tanks)
Discharge of washing bath after pickling (1 5,000 l tank)
Discharge of used flux bath (1 tank)
All effluents go to a 14,000 liter neutralization tank, where lime is added to keep pH around 6. Tank is filled with solution, so flow goes out as it comes in. They do not have information about the volume of water used and the amount of wastes discharged. Sometimes plain water is added to the tank to dilute acid wastes. There are plans to replace the neutralizing system by another one where pH would be monitored continuously. Eventually, defective parts or old structures must be reprocessed, though they are only a small percentage of total (0,4% in 1993). Defective processing because of steel compositions or structure geometry will result in the need for reprocessing. Operators change the pickling bath by their experience, taking into account the time that is required for the process. Also, consider the amount of pickled material and the age of solution to decide whether to add more acid or replace the whole solution. Flux bath is discharged when spots appears in the surface of processed parts. Liquid wastes have not been analyzed. Oil and grease is accumulated in the surface of baths. This is normally skimmed off. Sometimes structures are sand-blasted to remove grease before pickling.

Solid Wastes:

Sludges, as well as lubricants and other solid wastes are handled by a private waste disposal company.

Possible Actions:

Gerardo Bravo thinks it would be possible to use rinse water to prepare pickling solution. When structures go from one bath to the next there is not an especial care to give enough time to allow a better removal (by dripping) of the last solution. When structures has to wait on the line for the next bath there is not an especial care to let the dripping fall into the tank the solution comes from. Make up and discharge of solutions could be performed on the basis of quantitative measurements such as pH, solids, etc.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **GRAFICOS SMIRNOW, S.A.**
Santiago, Chile

INDIVIDUALS MET: **Danilo Avila Pizarro, General Manager**
Jorge Castillo Guzman, Production Manager

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 22, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Smirnow offset-prints and binds accounting ledgers, school notebooks and record-keeping forms. There are two locations. Most printing and all binding are done at Maria Auxiliadora 779 where there are 12 German offset presses. Santa Rosa 3660 is mainly a warehouse for raw materials but also has two small printing presses and a photo shop developing offset plates using kits supplied by Kodak and Fuji. There was not time to visit the Santa Rosa location, but we were assured that all wastes at the site are dumped down the sewer. The plants work two shifts of 12 hours each five days per week employing 170 process workers, 80 administration and sales personnel and an additional 50 people in production during the peak season at the end of each year. The standard short visit questionnaire was given to Mr. Avila during the visit.

OBSERVATIONS: The interview began with a disclaimer from Mr. Avila that Smirnow's only waste is paper and that all of it is recycled. They have a line of "ecological" products made with recycled paper. The meeting was then turned over to Mr. Guzman who repeated these points. A discussion of inputs and outputs followed. They have not tested their sewer effluent and do not intend to until absolutely necessary. Mr. Guzman estimates the plant's water discharges to the sewer at 30 liters per hour. They do not use a boiler.

Some of the inks used by Smirnow contain chrome and cadmium and possibly lead (as lead chromate). They estimate that 5% of their inks contain RCRA metals. Data sheets I have seen in other Chilean companies do not contain enough information to tell whether pollutants of concern to the sewer authorities are in the materials. The manager could not find anyone who knew whether Smirnow had any data sheets on printing inks. Neither he nor the print shop manager had ever seen them. If 5% of Smirnow's inks contain 4% cadmium, and if more than 0.8% of that ink goes to the sewer, the entire effluent will, on the average, be beyond the legal limits for cadmium. The difficulties of controlling ink wastes to this degree was apparent to Mr. Guzman. A discussion of the advantages of eliminating the use of metal-containing inks followed.

A tour of the facility revealed that leaded gasoline was being used to clean cloth-covered press rollers. Mr. Guzman told us he would immediately switch to unleaded. The cleaning mixtures used are unusual. To clean rubber and metal rollers, Smirnow uses a mixture of water, kerosene and detergent. To clean cloth-covered rollers, they use water, leaded gas and detergent. It would seem reasonable that the addition of gasoline or kerosene to a water/detergent mix would merely consume some of the detergent and not enhance cleaning. I have never seen such mixtures in print shops before. Last year Smirnow used 4,500 liters of leaded gasoline, 4,500 liters of kerosene and 500 liters of purchased solvent (a ketone/alcohol mixture by the smell). Essentially all of this solvent is used for cleaning presses. What does not evaporate to the air is discharged to the sewer or sent to the landfill on rags.

Inks are purchased in 1 and 5 kg cans. Smirnow uses about 6,300 kg per year both directly imported and compounded in Chile from imported ingredients. Mr. Guzman is sure that some contain Cd, Cr and/or Pb. The names of many of the inks contain the words cadmium or chromium. Ink not used in a run is put back in a can, frequently not the can it came from by the looks of the stock. The can is left open so the workers can tell what color, or what rainbow of colors, it contains. The ink skins over, of course, but Mr. Guzman stated that the film does not prevent the reuse of the ink. While examining these cans he got ink on his hands. While he cleaned his hands using a rag soaked in solvent, we were watching the wind blow the oil leaking from a valve on a 55 gallon lube oil drum into the sewer. At this point he wrung the excess solvent from the rag directly into the sewer. It was as natural a motion as waving goodbye to your kids in the morning. Given the estimated sewer flow rate of 30 liters per hour, the limit for hydrocarbon releases to the sewer is 10 grams per day. That limit was easily exceeded by a few minutes of leakage from the oil drum valve, much less the solvent from the rag.

Machinery oil leaks are collected in pans. If the oil contains any water, it is dumped to the sewer. Oil which is only contaminated with particulate matter is filtered through a coarse screen (about the same mesh as window screen) and put back in the machine sumps.

Adhesives for binding and labeling are compounded from poly vinyl acetate (PVAc) or poly vinyl alcohol (PVA), flour and water. They are applied by passing paper over a roller. Waste is minimal, consisting of what clings to the walls of the tray under the application roller when the trays are cleaned with water (into the sewer) at the end of each work day. Smirnow purchased about 15,000 kg of PVAc-based adhesives in the past year. The degree of alcoholysis of PVAc to PVA in the adhesive used by Smirnow is unknown. PVAc is more resistant to biodegradation than is PVA. BOD5 testing of the plant's effluent is necessary before the it can be known whether it will be necessary to re-examine adhesive wastes. A varnish is used on some product covers but the identity of the solvent used in it could not be determined. Last year Smirnow used 330 liters of this varnish. The chemicals used in the photographic and (possibly) etching operations at the second location were not identified.

Smirnow sends solid wastes to the municipal landfill which include RCRA-metal-containing inks,

solvent-soaked rags and containers with photographic chemicals. Wastes known to be discharged to the sewer contain leaded gas, kerosene, ketones, alcohols, PVA, wheat flour, varnish, inks containing (lead?), chrome and cadmium, photo chemicals, and lubricating oils. Air emissions include gasoline and kerosene components, ketones, alcohols, esters and varnish solvent.

WORKER EXPOSURE TO TOXICS: Workers use leaded gas in a detergent solution to clean rollers. It is hard to think of a better way to deliver lead directly to the blood. The detergent and gasoline both remove fat from the upper layers of the skin which increases the permeability of the skin to the organic lead ingredient in the gas and the cadmium and chromium pigments in the inks. To compound the problem, workers wash up for lunch and wash their plates and utensils after lunch in the same sink in which roller cleaning is done.

The other issue of immediate concern is exposure of worker's families to the RCRA-metal ingredients in inks. Workers' clothing contaminated with lead, cadmium and chromium is laundered with family clothing in the home. This is a well-documented pathway for non-worker exposure.

POLLUTION PREVENTION OPPORTUNITIES:

1. Change Inks.

   Change to inks which do not contain RCRA metals. This will require identifying inks which contain metals as a first step. Action by the graphics arts trade association to obtain this information is suggested. See the Recommendations section.

2. Stop the use of Leaded Gasoline

   Immediate elimination of the use of leaded gas immediately will reduce worker exposure and cut lead releases to the sewer.

3. Change Cleaning Formulation

   A mixture of petroleum solvents and detergent does not clean as well, as cheaply, or as safely as detergents designed for this purpose. Smirnow's ink supplier should have such products. If that line of inquiry fails, the Santiago area graphics arts association should have members who use other cleaners.

4. Repair Two Oil Leaks

   One press has a continuous oil leak. Repairing it would save oil, reduce the possibility of contamination with improperly filtered oil from leaks and reduce releases to the sewer. A leaking valve on a 55 gallon drum of lube oil should be repaired or replaced. It is leaking oil directly into the sewer.

RECOMMENDATIONS: Smirnow is a suitable candidate for a standard PPDA. The opportunities outlined above could be examined in detail during the PPDA and those requiring industry-wide co-operation could be developed further.

EP3 should assist Smirnow and the rest of the Chilean graphics art industry in phasing out their use of RCRA-metal-containing inks. A letter should be written to ink suppliers asking for information on the content of inks and their degradation products. This letter should be modeled on the one that EQC suggests for use by the Textile Association to determine the ingredients of concern in dyes. A draft of that letter is attached. The Textile Association is the best candidate for the first use of such a letter because:

1. The founder of the association, Fuad Garib, owns HiTEGA, S.A. in which EP3 has just completed a PPDA. Mr. Garib expressed interest in the idea at the exit interview for that assessment;

2. Mr. Garib recommended that the idea be discussed with the association's technical chief, Fernando Lopez of Proquindus. Proquindus is also a PPDA client of EP3 and Mr. Lopez has been an enthusiastic supported of the program;

3. The graphics arts industry may in some way be the domain of German assistance according to Juan Carlos Diaz.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests a reply to the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Includes a list of opportunities 2-4 above and a statement that EP3 will attempt at a later date to help Smirnow obtain data on the composition of their inks.

Within two weeks of the first letter:

1. Gather all requested information:

2. Ask Mr. Guzman if he has switched to unleaded gasoline and repaired the leaking oil drum valve. This will tell us if discussing easily-implemented options during short visits is useful.

3. Ask Mr. Guzman if he has inquired with his suppliers or other printers about an alternative to cleaning with petroleum/detergent mixtures.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **GRAFICOS SMIRNOW, S.A.**
Santiago, Chile

INDIVIDUALS MET: **Danilo Avila Pizarro, General Manager**
Jorge Castillo Guzman, Production Manager

EP3 TEAM: **William Bilkovich, Mauricio Roldán, Jorge Castillo, Jorge David**

Date of Visit: **March 22, 1994**

There exist two separate plants. The one in Santa Rosa 3660 is used mostly as a warehouse for raw materials and also have the equipment for photo mechanical processes and a couple of small printing presses. In the other one, at María Auxiliadora 779, are most of the equipment for printing and binding. Plans for moving to a unified site in Lo Espejo, an industrial area to the south of Santiago, are being evaluated at present. A decision should be made by March 24. If the plant moves an increase in the binding is expected, but not in the printing production. 250 people work in both plants, in two shifts, of which 80 perform administrative duties. In peak demand season, at the end of each year, additional 50 to 60 workers are temporarily hired.

Air Pollution:

Only electricity is used as a source of energy, so there are no emissions from fuel burning. However, the use of volatile organic solvents is significant and no safety measures have been taken to protect workers or to avoid its discharge to outside air. Energy consumption is about 60.000 KWH/month (2.5 million + IVA). Peak demand is important in term of energy costs. Since there is no space for transformers, electricity is taken directly from 380 three-phasic network. There exists two 100 KW intakes at María Auxiliadora plant and one 130 KW intake at Santa Rosa's.

Wastewaters:

All the water used in the plant comes from EMOS. There exists a softener but is not in use. Chemical are used instead. Every material that flows is disposed of through the sewer system. Wastes include used inks and machine cleaning solutions. Binding operations are mostly manual. A machine is used to spread adhesives to the surface of paper. Its roller and tray are cleaned after each use. Roller adhesive is wiped off. Unused adhesive in the tray is stored back. Tray is removed and cleaned with plain water. Estimated surface of tray is about 2,500 cm^2. Adhesive is a mix of 50% PVA and 50% flour gruel. PVA use is about 300 kg/week. Also, another adhesive is used at a 100 kg/week rate. Printing machines rubber and metal rollers are cleaned with a mixture of kerosene, water and detergent. Cloth roller are cleaned with a mixture of water, gasoline and detergent, and then rinsed with plain water. Cost of kerosene and gasoline is about 100.000 $/month, which is

equivalent to 30 l/day, assuming an average cost of 140 $/l. Also hardware store type solvents are used for cleaning purposes at a rate of about 500 l/year. No solvent recovery is practiced in the industry.

A rough estimation indicates that each machine (3 big offset machines and two small printing machines) generates about 0.5 l/min of liquid wastes. Inks are used with no special care, except for especial "ecological" products. Offset inks purchases are about 6,350 kg/year. Of these, about 5% could contain cadmium, chromium or other metals at unknown concentrations. Data and safety sheets are not used nor available at the plant. Partially used cans are often stored open, allowing for surface solidification and dust contamination. About 330 liter/year of varnish is also used in the printing process at the plant.

Solid Wastes:

Solid wastes are made up mostly of paper, which is sold out for recycling, and partially empty ink or chemical cans, solvent wet wipers. This last fraction of wastes is disposed off at sanitary landfills by the public solid waste service.

Possible Prevention Actions:

Replace metal inks by harmless ones. Use harmless solvents for cleaning or use protection equipment for the workers. Do not dispose forbidden chemicals to the sewer (flammable or volatile substances are not allowed by Chilean standards). Separate used cans or other solid waste that could contain pollutants for a especial disposal.

VISIT REPORT: **Jorge David**

INDUSTRY VISITED: **GRAFICOS SMIRNOW, S.A.**
Santiago, Chile

INDIVIDUALS MET: **Danilo Avila Pizarro, General Manager**
Jorge Castillo Guzman, Production Manager

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 22, 1994**

OBSERVATIONS AND SUGGESTIONS

1. Industry: SMIRNOW S.A., Talleres Gráficos, Santiago, CHILE

2. Type of Process: Graphics - Printing.

3. Observations:

3.1 WATER:

3.1.1 SUPPLY: Metropolitan Network (EMOS).

3.1.2 USE: Kept to a minimum.

3.1.3 DISCHARGED:

- Not measured, but known to contain toxic paints, solvents, kerosene, leaded gasoline, detergents and oils
- Estimated @ 30 liters / hour by the production manager.

3.2 RAW MATERIALS:

3.2.1 Paper & Cardboard: No potentially toxic components expected.

3.2.2 Paints:

- Total consumption = 6 350 kilos/year
- Special paints account for some 5% of their consumption
- The special paints contain Chromium and/or Cadmium

3.2.3 Solvents:

- Total consumption = 12 000 liters / month of Kerosene and leaded gasoline
- Some minor amounts of ketones + ethyl acetate + methanol blends also used

3.2.4 Adhesives:

- Mainly PVA = 1 200 kilos / year
- Other types = 400 kilos / year
- Wheat flour (for gruel) = ~ 400 kilos / year

- The adhesive is 50% PVA / 50% Gruel

3.2.5 Other materials:

- - Varnish = 330 liters / year.
- - Lubricants = ?
- - moisturizers = ?

4. Pollution Prevention Opportunities:

4.1 Water: Use is apparently minimal.

4.2 Paper: Recycled (also wood from pallets is given away for firewood).

4.3 Paints: Due to the toxic nature of some, they could be handled separately and with greater care and warnings, keeping Safety Data Sheets on site. As soon as possible they should switch to heavy metal-free paints.

4.4 Solvents: Eliminate leaded gasoline immediately. Switch to detergents, eliminating hydrocarbons from the process, as health hazard, fire risk, and wastewater pollutant.

4.5 Adhesives: Minimize waste and attempt recovery from cleanup for use in less quality demanding uses or giveaway, thus reducing wastewater load (BOD).

4.6 Varnishes: Investigate use of varnishes with minimum volatile organic compounds, or work under hood.

4.7 Lubricants: Reuse after microfiltering. Recycle.

4.8 Moisturizers: Although most of it becomes part of the final product, the possibility of reuse after filtering or reconstituting could be investigated.

4.9 General: A Preventative Maintenance Program can prevent leaks and losses of expensive (and polluting) oils and of materials, and even of finished product that might turn off-spec.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **CECINAS LA PREFERIDA S. A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pedro Marin, General Manager**
Walter Ahrend, Production Manager

EP3 TEAM: **William Bilkovich, Jorge David, Jorge Castillo**

Date of Visit: **March 22, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Preferida processes 300-350 metric tons of pork and beef per month. Some pork meat is sold directly as hams and cutlets. The remaining pork and all beef are processed into sausage, sliced and ground products. Fifty-five production workers and 20 support staff work 9.5 hours per day Monday-Friday. The standard short visit questionnaire was given to Mr. Ahrend during the visit.

OBSERVATIONS: Preferida would like to expand production capacity. Concerns about the quality of supervision available on the second shift preclude expanding by adding another shift. The commune will not allow any physical expansion. They are about to purchase a property on the periphery of Santiago. A number of improvement to work flow patterns and equipment will be made at the time of the move.

Preferida uses 3,800 cubic meters of EMOS water per month. Less than 5% of this water is incorporated into products. About 10% is softened for boiler use and a closed-loop air conditioning system which loses small amounts of water to evaporation. Clean-up is done with buckets instead of hoses and seems to use a minimum of water. The largest single use of water is for cooling cooked hams. Hams are cooked in reusable aluminum containers. The containers are then racked on carts, moved to one of two rooms, and cooled by spraying with water. The water is discharged directly to the sewer. The spray is shut off after a time interval determined by operator experience and work flow. The team discussed some alternative ways to determine the end point of cooling. It might be possible to both save water and increase production by shortening the cooling cycle.

Two small boilers are used, both burning number 2 oil. One has automatic combustion control. Its particulate emissions have been tested at 56 mg/m^3. The other has manual (by sight) control and tested at 70 mg/m^3. Preferida will install a gas-fired boiler when they move to a new facility. They smoke meat by two different methods using 7,500 kg/year of eucalyptus and red oak sawdust. One

smoker exposes the meat to dry smoke vapors which pass over the meat and out the stack. The air pollution authority could not find a standard for such smoking and therefore told Preferida to reduce emissions as far as possible without requiring any testing. The other method confines the smoke and meat in a closed chamber. When smoking is complete the chamber is cooled with water and then opened. No smoke is emitted in this process, but the cooling water, which is sewered, may be contaminated with phenols.

The Secretary of Sanitary Services has not yet requested that Preferida's effluent be tested. Preferida has interpreted this to mean that they do not have an effluent problem. When testing is requested, the most likely problem parameters will be BOD and oil/grease. There are four grease traps located in the sewer lines. They are emptied once per day, yielding 40 kg of wet grease each. The grease used to be sold to a soap factory, but is now discarded with the daily trash. Apparently, the amount of grease did not justify the transportation expense. The grease from the traps has a high water content and would be difficult to accumulate on-site in a sanitary manner. When effluent testing is done, it is likely that a more efficient grease trapping system will be needed. That system may produce a more salable waste.

Solid waste is hauled each day. Mr. Ahrend estimated that 1,200 kg per day are hauled at a cost of $12.45 (US) per metric ton. The largest single solid waste is 300-500 kg/day of bones.

POLLUTION PREVENTION OPPORTUNITIES:

1. Recycling of Bone

   It is possible that Preferida's meat suppliers would be willing to collect waste bone when they deliver meat. Sanitation would be the main concern. A collection facility and container system could be designed at the new facility.

2. Reducing Water Use

   Water used to cool hams could be reduced by using temperature information to shut off cooling water. A temperature probe could be placed in the middle of the rack of containers. Experimentation would develop a correlation between ham temperature and this probe. Alternatively, a special container with a temperature probe inside could be constructed. This second method would be less susceptible to minor variations in spray pattern. In either case the temperature sensor signal would be used to shut off cooling water. This would free up operator time, save water and increase production capacity which is now limited by cooling time.

RECOMMENDATIONS: Preferida is a very well-run facility. It is not a suitable candidate for a full scale PPDA.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests a reply to the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Includes a summary of the two pollution prevention options discussed above.

If the requested information has not been received within two weeks of the first letter, a followup call should be made.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **CECINAS LA PREFERIDA S. A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pedro Marin, General Manager**
Walter Ahrend, Production Manager

EP3 TEAM: **William Bilkovich, Jorge David, Jorge Castillo**

Date of Visit: **March 22, 1994**

Though plant is in accordance to most regulations at present (at least those that have been enforced in this particular industry) because of its location in a residential area Providencia Municipality would not allow for any expansion or substantial modification. For this reason the plant would eventually move to 50.000 m^2 land in an industrial area to the north of Santiago.

Increase of production through the work in two or more shifts, instead of the one now in use, is not attractive for them because would require more qualified and trained personnel, which is difficult to get, would require more supervision, and would require to expand their market to other than Santiago and neighboring cities. The main reason or building a new plant is to have more space to improve the working conditions. La Preferida seeks to produce only for an elite sector of the demand.

Air Pollution:

Boilers are OK, burn diesel fuel and particulate mater has been measured at 56 grams/m^3. By 1997 they think the plant would working elsewhere. Have problems with smokers and cooker-smokers. Since there not emission standards for that kind of sources, PRODEFF asked them to "do something" to solve the problem. Smokers and cooker-smokers use sow dust of eucalyptus and red woods (such as oak, etc.), apparently free from wood treatment chemicals. They are not sure about this and only trust their suppliers. Saw dust use is about 30 kilos/day (5 days a week).

Liquid Wastes:

EMOS supplies all the water for the industry at an estimated rate of 3,800 m^3/month. Soft water is used for boilers and for the refrigeration system. About 200.250 kilos of salt are used each month. Nitrites are added to pork to improve its appearance (oxidizes hemoglobin). Could get to washing water and show up as a contaminant. Hard water is used for floor and equipment clean up, washing machines, cooking, and spray-cooling. This last use seems to account for most of the water use at the plant. Clean up is performed using supposedly biodegradable detergents (Lever), usually with warm water and with hydraulic pressure machines when possible. Wastewater passes through a small chamber where floatable are removed daily. Settling material is temporarily retained and then

discharged once a day (?). There four of these chambers in the plant. A small proportion of water, not exceeding 10% by weight, is also incorporated to the product. Production is about 300 to 350 tons/month.

Solid Wastes:

None of the solid wastes with residual value are sold, to avoid accumulation in the plant. About 1.200 kg solid wastes are produced each day and disposed by a private waste disposal company. Greases removed from the wastewater chambers total about 4-5 bags/day.

Possible Actions:

Remove solids from floor before cleaning up with water.

Improve cooling system by stopping the process when water temperature reaches a given value.

VISIT REPORT: **Jorge David**

INDUSTRY VISITED: **CECINAS LA PREFERIDA S. A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pedro Marin, General Manager**
Walter Ahrend, Production Manager

EP3 TEAM: **William Bilkovich, Jorge David, Jorge Castillo**

Date of Visit: **March 22, 1994**

OBSERVATIONS AND SUGGESTIONS

1. Industry: CECINAS LA PREFERIDA S.A., Santiago, CHILE

2. Type of Process: Pork Meat Processing Plant. Production = 300 - 350 MT / month.

3. Observations:

3.1 Water:

3.1.1 Supply: Metropolitan Network (EMOS).

3.1.2 Use: Rather moderate use, but can be improved. Consumption = 3 800 m3 / month (US$ 1 000 - 1 200 / month).

3.1.3 Discharged: Not measured or analyzed, but expected to contain fats and oils, organic load (BOD), and probably phenolic compounds from the condensates of the smokers/cookers.

3.2 Raw Materials:

3.2.1 Pork and cattle meat: No potentially toxic components expected, unless hygienic standards were not met.

3.2.2 Curing salts: ?

3.2.3 Saw dust: Total consumption = 7 500 MT / year to be used in smoking some products.

3.2.4 Other materials: Only natural, no substitutes used.

3.2.5 Other accessory materials:

- - Lubricants = ?
- - Biocides = ? (Non-chlorinated ones).

4. Pollution Prevention Opportunities:

4.1 Water: Use is apparently very rational. Use in cooling product hot from cookers may be minimized by implementing a system of side showers and a blower. This setup

would also shorten residence time in cooling chambers.

Cleanup: Although no hosing is done, use of buckets and push brooms mean minimal waste of water. However, they should first attempt dry pickup of residues before washing. Maybe some of this is done, but it was not seen at the time of our visit.

Ice storage: An estimated amount of 2 m3 of ice was seen standing in a stainless steel basin. An insulated container should be used to prevent wasting energy used in freezing water.

4.2 Pork meat: Bones are wasted as solid residues because no purchaser has been found that would collect small amounts on a daily basis. However, at some 300 kilos / day there may even be a chance for their suppliers of meat (slaughterhouse) to collect them to add to their own stock whenever they deliver.

4.3 Sanitary conditions: Even though this subject is beyond the scope of EP3 assessments, if considered under the criteria indicated in 3.2.1 above, a microbiologically contaminated lot means expensive wasted product, and therefore any efforts made to prevent such occurrence shall be recommended:

- Foot baths: Particularly at the entrance of employees and raw materials, there should be sanitary baths.

- Crossing of raw and cooked products: The presence of both raw and cooked product in one room is not recommended, particularly if they are being moved past each other while being processed.

- Handling of cooked product: A worker was observed pushing a cart filled with a ham paste, with both thumbs dipped in the paste. Such occurrences should be prevented by the use of a sanitary plastic film on top of the cart, or the use of medical gloves and masks or better yet, all of the above.

4.4 General: Other than the observations above, the place looked appropriately clean and well maintained. The machinery is cleaned thoroughly and under adequate sanitary conditions, by using approved detergents and biocides. No strong odors were detected in any of the areas visited.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **GALVANOPLASTIA**
SANTIAGO, CHILE

INDIVIDUALS MET: **Eduardo Brenner, Owner**

EP3 TEAM: **Deborah Hanlon, William Bilkovich, Jorge Castillo**

Date of Visit: **March 23, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Galvanoplastia electroplates copper, nickel and chromium on steel. A small amount of aluminum and brass are also chrome/nickel plated. The facility has been in use as a plating shop for thirty years. In the past the primary business has been re-plating vehicle bumpers. Over the past few years the volume of such plating has slowly fallen as newer cars with rubber and plastic bumpers replace older models. Galvanoplastia has diversified by expanding into the market for chrome-plated roll cages, skid plates and other accessories for pick-up trucks. These accessories are fabricated by a subsidiary, Metallurgica Munchen, located in the same building, and then plated by Galvanoplastia. The two businesses employ 40 people working one shift Monday through Saturday. The standard questionnaire was given to Mr. Brenner.

OBSERVATIONS: All liquid effluent in the plant runs in channels in the floor. These channels lead to a small sump under the floorboards of the main plating area and from there effluent flows directly to the city sewer. Galvanoplastia does not have any pretreatment system. They have not received a letter from the sewer authorities and have not tested their effluent for any of the parameters of concern. The average monthly water bill is $430 US for 1,500 cubic meters. Electricity costs about $2,000 per month. The standard short visit questionnaire was given to Mr. Brenner during the visit.

Bumpers are de-painted, cleaned, de-plated in sulfuric acid, acid pickled in hydrochloric acid (to remove rust), polished and detergent washed before plating. Fabricated parts from Munchen join the process at the acid pickle stage. Plating proceeds along two pathways depending upon customer preference. Some parts receive an alkaline cyanide copper strike followed by an acid copper strike. They and all other parts are then plated twice with nickel followed by one layer of chrome. Parts are dried in sawdust.

The de-painting through acid pickle steps are done in the cleaning room. The concrete floor in this room has been severely corroded by hydrochloric acid. Paint is removed by one of three methods: burning with a torch; applying a caustic gel which may contain methylene chloride and sodium hydroxide, and; dipping in hot caustic soda solution. All rinsing for these processes is done with hard water by spraying with a hose over a sump. The rinse hose is left running continuously at all times. A worker stated that the water was left running to dilute the chemicals in the effluent so that they did not eat up the pipes. We measured the flow rate of this hose at 9.5 liters per minute, about 10% of all plant water use. The caustic soda tank is periodically replenished with sodium hydroxide solution. Mr. Brenner stated that he cannot remember ever dumping the tank or removing sludge from it.

The 3,000 liter de-plating tank uses lead electrodes in sulfuric acid solution to electrolytically remove chrome and nickel from parts. Three times per year, when the sludge level rises to the point where parts can no longer be submerged, the liquid portion of the bath is removed, the sludge transferred to plastic bags, and the liquid replaced. Each cleaning yields about three tons of chrome/nickel sludge which is sent to the city landfill. An extra charge of $100 per load is assessed.

The 1,000 liter acid pickling tank is periodically refilled with hydrochloric acid to make up for drag-out. As with the caustic soda tank, Mr. Brenner stated that he cannot remember ever dumping the tank or removing sludge from it. Grinding, polishing and buffing of parts is done in a room adjacent to the plating room. Bulk grinding materials are glued to re-usable pads. Most workers were not wearing masks while grinding during our visit. After final polishing, parts are scrubbed by hand in a hot alkaline detergent solution in a 200 liter tank. This tank is dumped every five days. It is not oil-skimmed or filtered. After this cleaning, parts go directly to plating.

All plating is done in the room adjacent to the cleaning room. Electroplating and rinse tanks are either 1,500 or 2,500 liters. Some solutions are heated with electrical emersion heaters. Electroplating solutions are made up with and refilled with deionized water. Use is between 300-400 liters per day. The DI units are regenerated after 1,500 liters. The nickel and chrome baths are batch-filtered each morning. No bath is continuously filtered. Sludge from filtering is discarded with other solid wastes.

All rinsing is with hard water by overflow in one of two rinse tanks. There are no flow restrictors in use. All rinses are constantly running, even during lunch, but we were told that the water is shut off over night. The chrome tank is followed by a dragout recovery tank. Recovered solution is returned to the chrome tank. No other dragout recovery provisions are used on any other cleaning or plating baths.

WORKER EXPOSURE TO TOXICS: The workers eat lunch in the plating room. The hexavalent chrome tanks have no ventilation system so workers eat in a chrome mist. A new enclosed lunch room has been built above the present eating area. The new room is closer to the chrome tank and probably will be exposed to higher chrome mist concentrations because it is above

the level of the tank. It needs to be separately ventilated or exposure levels might be higher than they are now.

Workers who grind nickel off bumpers are exposed to fine nickel dust, an OSHA carcinogen. The room should have a functioning dust collector and more emphasis should be placed on the dangers of not wearing dust masks.

All dragout and rinse streams go to the same sump. Alkaline cyanide dragout is routinely mixed in the sump with acid wastes from other processes. In addition, the alkaline copper cyanide bath is next to the acid copper bath and parts are run across the acid bath while dripping cyanide solution. The plant has been operating for many years with the present sump configuration and tank layout. Assumedly, no one has died. The potential exists, however, for the evolution of large quantities of HCN.

POLLUTION PREVENTION OPPORTUNITIES:

1. Replace Alkaline Cyanide Copper with Alkaline Non-cyanide Copper

   These bath chemistries have been proven. Costs are similar. Eliminating cyanide will eliminate the chance of worker exposure and greatly reduce the cost of pretreatment.

2. Recover Chrome/Nickel De-plating Sludge

   Nine tons of wet sludge may contain enough chrome and nickel to make the search for a Chilean recycler worthwhile. Continuous filtration through a filter press would yield a drier sludge and a better-controlled process.

3. Improve Dragout Recovery

   There are at least five opportunities to recover chemicals and reduce releases by installing dragout recovery systems.

4. Improve Rinsing Efficiency

   Every rinsing practice in the plant could be improved, reducing water use and increasing recovery opportunities.

5. Recover Grinding Dust

   This opportunity will seem to have a long payback unless the savings from avoided worker cancer are included in the benefits.

6. Continuous Filtration of Process Baths

   Plating chemistries would be held to tighter tolerances if baths were continuously filtered.

RECOMMENDATIONS: Galvanoplastia is a good candidate for a Pollution Prevention Diagnostic Assessment. There are many low cost P2 opportunities. The avoided costs, in the form of soon-to-be-required pretreatment equipment, are high. There are some important worker safety issues that could be dealt with during the assessment. The P2 opportunities Galvanoplastia are most likely common in Chilean electroplating shops, because they reflect conditions common in North American shops just a few years ago.

The principal that pollution prevention should precede pollution control is clearly applicable here. Electroplaters will have to install some sort of pretreatment plants unless they can close-loop their processes and eliminate the use of cyanide. At this early stage of environmental development, Chilean electroplaters may be willing to make investments in such technologies to avoid the costs of pretreatment. We might be too early in the process for electroplaters to actually believe that a regulatory crunch is coming, but EP3 does have the advantage of being able to describe the sequence of events that electroplaters in the United States went through. The money which North American firms could have saved by doing pollution prevention first may be enough to convince Chilean firms to be proactive now. Galvanoplastia is a chance to test this hypothesis.

I would recommend Terry Foecke for this assessment. He speaks Spanish, has lived in Santiago and knows electroplating better than anyone in the P2 community. He has the added advantage of understanding P2 training and how to deliver it to small businesses. His project with small electroplaters in Pakistan comes to mind.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

Within two weeks of the first letter:

1. Gather all requested information;

2. Decide whether Galvanoplastia is a candidate for a full assessment.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **GALVANOPLASTIA**
SANTIAGO, CHILE

INDIVIDUALS MET: **Eduardo Brenner Owner**

EP3 TEAM: **Deborah Hanlon, William Bilkovich, Jorge Castillo**

Date of Visit: **March 23, 1994**

Industry electroplates with nickel, chromium, copper and brass. Most of the plated pieces are repaired bumpers and car parts from external clients, that need removal of paint, old plating, and rust. 40 people work in the plant, from Monday to Saturday noon, in 1 shift.

Paints removed usually by fire,with a burner. If the piece is made of aluminum or too thin for the use of fire, a paint removal solvent, in the form of a jelly, is used (sold by Pinturas Andina). Sometimes a hot caustic soda (sodium hydroxide) bath is used. Soda is kept in a 500 l tank and, according to information supplied by Brenner, never changed. Only make up soda is added.

Old chromium and nickel plating are removed in an electrolytic sulfuric acid bath, that uses lead electrodes. Acid is kept at about 55°Bé by make up additions.

Three times a year the sulfuric acid solution is removed from the tank and about 3 tones of high nickel concentration sludge is removed in polyethylene bags, which are disposed off by a private company. Tank is cleaned out when solids occupy one half of the total volume, and pieces cannot be submerged in the solution.

Rust removal of is done in a 1,000 liter 28% hydrochloric acid bath followed by spray rinse with a running hose.

Polishing is done with a 3 HP grinder. Polishing wheels are prepared in the plant using felt, and adhesive and abrasive material of various grain sizes.

After polishing pieces are washed in a 200 liter 50°C sodium hydroxide bath, which dumped every 5 days. Pieces are scrubbed with plastic gloves and brush.

Next is a 2,500 liter electrolytic degreasing bath with sodium hydroxide and cyanide, at ambient temperature, for parts cleaning and surface preparation. Make up reactants are added to this bath but it is never dumped.

After this is an overflow rinsing bath and a 1,500 liter acid bath to remove the rust formed in between and neutralize.

Plating:

There are two different parts preparation processes, but both end up in the chromium tank.

One starts with a 2,500 liter nickel plating bath, followed by a second 2,500 5°C nickel bath and overflow rinsing.

The other one starts with an 1,500 liter alkaline copper and cyanide bath, followed by rinsing and neutralizing with 10% sulfuric acid, acidic copper bath, 2,500 liter 55°C nickel bath, and overflow rinsing.

Chromium plating is done in a 2,500 liters capacity tank and takes only 5 minutes.

After this there is a batch rinse and then an overflow rinse. Batch rinse water is used for making up the chromium bath.

Parts are finally dried with saw dust

Chromium and nickel bath are continuously filtered by an external pump and filter system. They have never been dumped. Disposal of sludge costs about 100 US$/trip.

Electric bill	:	2,000 US$/month
EMOS	:	water 72,848 $/1,300 m^3 (February 94)
		sewer 25,000

About 500 liter a day are demineralized for metal tanks. Demineralizer regeneration uses hydrochloric acid and sodium hydroxide.

Possible Prevention Action:

Use continuous submerged filter in sulfuric acid, nickel, and chromium tanks. Reduce solution or water contamination by improving dripping of parts in the same tank where they are taken off. Should optimize time so as to prevent rust formation. If had more space, could reduce overflow rinsing water by using sequential tanks batch rinsing with counter current replacement of water.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **QUIMICA MIRALLES LTDA.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Carlos de la Cruz Reixach, Technical Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Quimica Miralles, Ltda consists of three business units in one location. Quimica Miralles is a trading company dealing in rubber, plastics, solvents, chemicals, and medical supplies and equipment. Madesa produces industrial solvent-based adhesives. It has seven employees working one shift six days per week. Madegom employs 190 workers on three shifts six days per week producing latex medical products. The team examined the production facilities of Madesa and Madegom and the combined warehouse of all three companies. The standard short visit questionnaire was given to Mr. de la Cruz during the visit. Wastewater effluent has been tested for total suspended solids, but no other parameters.

OBSERVATIONS: The warehouse is shared by all three companies. Raw materials are arranged by the order in which they are received. This has resulted in some dangerous storage conditions. Strong oxidizers and acids are being stored next to bales of raw rubber and bags of sulfur. Reactive materials are stored on top of combustibles. The team briefly discussed the possible consequences of such storage with Mr. de la Cruz.

MADESA

Madesa makes adhesives by mixing polymers with solvents. They have four main products.

1. Abereno 70 is a shoe assembly adhesive containing 25% solids. The solvent is a 50:50 mix of toluene and petroleum naphtha. They make 240 tons per year, which accounts for 22% of the Chilean shoe assembly adhesive market.

2. Rubber cement is 10% neoprene solids and 90% petroleum naphtha. Production volume is 108 tons per year.

3. Mirafix MI is a polyurethane-based shoe adhesive with 18% solids. The solvent is 80% a

mixture of equal amounts of acetone and methyl ethyl ketone and 20% toluene. Production is 84 tons per year.

4. Madesa produces about 2 tons per year of an adhesive containing 30-40% 1,1,1, Trichloroethane. They currently have no plans to phase out the use of this ozone-depleting substance.

High-volume solvents such as toluene, petroleum naphtha, and the 50:50 toluene:petroleum naphtha mix are stored in above ground tanks. Ketones are stored in drums. All adhesives are mixed in one of two 1,000 liter vertical tanks. Most solvent is piped directly from the above-ground tanks to the mixers through a manifold. The adhesive formulas are all similar enough to allow the slight mixing that occurs when the portion of the fill line between the manifold and the mixer is purged into the mixer with a new solvent. The mixers have hinged covers which were not secured and did not have gaskets. At the entrance interview, Mr. de la Cruz said he believed that solvent losses to the air were about two per cent of purchases. Judging from the odor of solvent in the mix and fill room it is more likely that solvent losses are closer to 20% of purchases.

The tanks are unloaded out the bottom into 200 liter drums. These drums are either shipped directly or used to move adhesives to the filling area. The mixers are cleaned with the solvent mix used to formulate the adhesive. The resulting cleaning solution is saved in drums until the next batch of that product is run and then used as part of the product mixture.

Adhesive is moved to the filling area in 200 liter drums which are used to fill 50 liter drums, 5 gallon cans, 1 gallon cans and 500 milliliter cans. The 500 ml cans are loaded from a filling machine operated by hand. The adhesive chamber cover on this machine is a loose-fitting piece of particle board which was not in place during our visit. The other container sizes are filled by tilting a 200 liter drum of adhesive on its side on a table, loosening the larger bung and controlling the flow into the container to be filled by removing and replacing a small bung modified with a T-handle.

The worker running the filling operation sits on a padded sawhorse next to the table with the 200 liter drum at about eye level. As the adhesive comes out of the drum the worker is exposed to high levels of solvent vapor. At 11 AM, the worker performing this job was clearly intoxicated by these vapors. His eyes were glassy and his gait slow and stiff. This is the lowest-rated job in the plant with the highest worker turnover rate. The team discussed the exposure problem with Mr. de la Cruz who said he has plans to ventilate the work space. We highly recommended changes which would isolate the workers from solvent vapors and yet minimize solvent losses to the atmosphere.

Water is not used for production purposes at Madesa. Solid wastes consist of drums returned from customers which are too damaged to reuse. They are sold for scrap without cleaning out adhesive residues. It is likely that some drums are cleaned by the recycler and reused for other purposes. Smaller containers are not recycled.

MADEGOM

The contrast between the operations of Madesa and Madegom could hardly be greater. Equipment at Madegom is well-designed and utilizes many methods to minimize resource use and wastes. Gloves are formed on ceramic molds which are connected to a conveyor line. The forms are in turn cleaned, rinsed, dried, coated with a coagulant, dried, dipped in latex, leached three times in soft water, starched, baked, labeled, removed from the molds and tumble-dried.

The cleaning section of the line uses nitric acid followed by a rinse and then an alkaline cleaner also followed by a rinse. The acid and alkaline baths are replenished based upon pH monitoring. The acid tank is dumped about every five days based upon turbidity. Dragout boards are used to recover both acid and alkaline solutions. All rinses are overflowing, but total water user is only 4 cubic meters per hour for the three rinses, about 20 liters per minute for each rinse. Since the rinse tanks are about 400 liters, the tank contents are changed about three times per hour.

Leaching is done in three successive soft water baths which are dumped on the basis of conductivity monitoring. The leached latex from these baths is probably the largest source of BOD and TSS in the plant's effluent.

Waste water effluent has been tested for total suspended solids but no other parameters. At 700 ppm it substantially exceeds the 300 ppm standard. The combination of acid and alkaline wastes will probably keep the plant's effluent within the 6-9 required range. Because ammonia is used to prevent latex coagulation, nitrogen limits might be exceeded.

Solid wastes consist primarily of rejected gloves. This latex material is sold to flooring manufacturers who use it as filler material.

POLLUTION PREVENTION OPPORTUNITIES:

1. Prevent Solvent Loss (Madesa)

   Better seals on the mixers and covers on the small-can filler would reduce losses. The filling operation for larger containers could be redesigned to recover vapor and protect workers from solvent exposure. This is not a high-speed filling line that requires a conveyor line for container movement. Some simple equipment could be designed and built inexpensively.

2. Increase Dragout Recovery (Madegom)

   At the exit of the nitric acid rinse tank the dragout plates could be extended to recover more nitric acid. The forms are still dripping after they pass beyond the current dragout plates.

3. Reduce Latex Discharge to Sewer (Madegom)

   The leach tanks could be continuously filtered to remove suspended solids. Whether BOD reductions are also needed cannot be determined until effluent testing has been done.

The following two recommendations are not strictly pollution prevention but were discussed with Mr. de la Cruz. The consequences of not making these changes increases the chance of substantial releases to the environment.

4. Reduce Consequence of Spills (Madesa and Warehouse)

   Neither the work area in Madesa nor the warehouse has any secondary containment for solvents and other liquids. The slope and location of the property is such that a spill would quickly find its way into a small stream that borders the property. ACHS (Asociacion Chilena de Seguridad) offers free assistance for planning containment structures.

5. Separate Incompatible Chemicals in the Warehouse

   The warehouse layout should be re-examined and changed to separate chemicals which could easily interact. ACHS can also help with this change.

WORKER EXPOSURE ISSUES:

The most urgent worker health issue is exposure to solvent vapors at Madesa. The suggestions made in Opportunity # 1 above would greatly reduce it. As long as solvent-based adhesives continue to be designed into the manufacture of shoes, these workers will need protection. The petroleum naphtha used by Madesa contains 20-25% hexane. Mr. de la Cruz mentioned that in the past naphtha with 90% hexane had been used. It caused neurological defects in shoe workers and presumably affected Madesa workers also. They now specify that hexane content must be below 30%.

RECOMMENDATIONS:

Quimica Miralles is not a suitable candidate for a full P2 assessment. The changes necessary at Madesa and in the warehouse are easily accomplished and help is available from ACHS. The changes suggested for Madegom are minor and very competent staff is available. I think it would be helpful for EP3 to encourage Madesa to implement their professed plan to reduce worker exposure through equipment changes. Creating a link between EP3 and ACHS would be another benefit of such follow-up.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;
2. Informs the facility of the availability of free pollution prevention training in the near future;
3. Informs the facility of the availability of a pollution prevention information clearing house;
4. Includes a list of Opportunities # 1-5 above

Within two weeks of the first letter:

1. Gather all requested information;
2. Ask Mr. de la Cruz what changes he will be making as a result of the opportunities listed in the first letter, especially what he intends to do to reduce exposure of workers to solvent vapors. If it would be helpful, EP3 should contact ACHS about supplying advice on equipment which would better contain solvent vapors.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **QUIMICA MIRALLES LTDA.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Carlos de la Cruz Reixach, Technical Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

Industrial plant contains three different companies under the same holding. These are MADESA, which prepares mainly adhesives for the shoe industry; Madegom, which manufactures natural latex (surgical gloves, nipples, catheters, etc.); and Miralles, a trading company.

MADESA prepares adhesives using different organic solvents, such as naphtha, ketones, acetone, and trichloroethane (TCE). All adhesives solvent content are under the maximum level allowed by the Chilean Safety Association. According to the plant technical manager mass balance of solvents shows and unbalance not greater that 2%.

In MADESA seven people work in one shift, including a laboratory assistant and the production manager. Main MADESA products are ADERENO 70, rubber cement and MIRAFIX. 20 tons of ADERENO 70 are produced monthly for the shoe industry, containing 70% solids and a 50-50% mix of toluene and naphtha. Rubber cement production averages 9 tons/month and contains 10% solids and 90% naphtha. MIRAFIX production is about 7 tons/month and contain 18% solids, and an 80-20% mix of ketone and toluol. Reactors are cleaned with a solvent which is stored in drums and used for next batch of the same product. No liquid wastes are produced from MADESA

Possible Prevention Actions:

Use bigger containers for transportation to the filling machines. Automatize cans filling or improve the manual filling to avoid or to reduce volatile compounds inhalation by the workers.
Build spill dams for containers to avoid the spreading of materials in case of accident.

MADEGOM manufactures mostly latex surgical gloves, plus other latex products. Main input materials, besides natural latex, are phenolic compounds used as antioxidants, zinc based accelerating compounds, zinc oxide used as an activator, calcium nitrate for latex coagulation, and ammonia as latex stabilizer. It works continuously in 3 shifts. There 120 workers plus 70 people in quality control. Effluents have not been tested.

Liquid wastes come from:

- cleaning of reactors
- solution dumps and rinse tanks overflow
- water softening and demineralization

Water is softened from 540 mg/l hardness to 2 mg/l. Though liquid wastes have not been tested, it is estimated that effluent water contains about 700 mg/l total impurities. Use of water in the gloves production line is of 4 m^3/hour. All the water softened and water used for reactors is demineralized.

Gloves Production Processes:

Nitric acid bath at 1 to 2%. Acid content is checked every hour, by titration, and made up if necessary. Usually 1 or 2 liters 10% acid are added every hour. Solution is dumped approximately every 5 days. From this bath to the next one there is a good prevention action already taken. A simple try prevents the dripping from this tank to fall to the floor and also reduces the amount of solution that has to be removed in the rinsing tank.
Overflow rinsing. Water should be kept with a pH higher than 5.
Caustic soda bath.
Overflow rinsing with cold water. pH must be below 9.
Overflow rinsing with hot water. pH must be kept below 8.
Drying.
Calcium carbonate plus calcium nitrate and surfactant bath for latex coagulation.
Drying chamber
Latex bath. Make up latex tank is stabilized with ammonia at 0,2%.
Gloves leaching in 3 leaching tanks. Soft water is used and changed when conductivity is equivalent to 1.000 mg/l dissolved solids concentration.
Drying chamber
Powder removal

Solid Wastes:

Are made mainly of scrap latex pieces. These are all sold as a fill material for the rubber industry.

Possible Prevention Action:

Though the gloves production line seems to be in good condition from the point of view of prevention, could be worth to study some additional actions, as these:

Try to reduce the dripping of solution from one tank to the next either by using longer trays or a greater dripping length.

The use of sequential rinsing bath with counter current water replacement could reduce water use

without changing the rinsing results. Also, under the existing conditions, could be good just to put the entrance to the overflowing rinsing tanks at the downstream end and keep the outlet at the upstream end.

VISIT REPORT: **Jorge David**

INDUSTRY VISITED: **QUIMICA MIRALLES LTDA.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Carlos de la Cruz Reixach, Technical Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

1. Industry: QUIMICA MIRALLES LTDA., Santiago, CHILE

2. Type of Process: Three companies on one site.

2.1 MADESA LTDA. - Producers of industrial adhesives.

2.2 MADEGOM - Latex medical gloves and similar items.

2.3 Q. MIRALLES - Traders of rubber, plastics, solvents, medical items, machinery.

3. Observations:

3.1 Water:

3.1.1 Supply: ENSA - Private suppliers (from well)
3.1.2 Use: Very moderate use, kept to a minimum.
3.1.3 Discharged: Not measured or analyzed, but expected to contain organic load (BOD), and phenolic compounds, and some salts such as Calcium nitrate, Zinc oxide, suspended and total solids.

3.2 Raw Materials:

A. MADESA:

3.2.1a Solids: Neoprene, rubber.
3.2.2a Solvents: About 340 MT/year.
- Toluene
- Naphtas (low hexane and benzene content)
- Ketones
- 1,1,1-TCE

3.2.3a Additives: None.
3.2.4 Other accessory materials:
- Lubricants = ?
- Packing material =200 and 50 liter drums, 5 and 1 gallon metal cans.

B. MADEGOM:
3.2.1b Solids: Latex.
3.2.2b Solvents: Water.
3.2.3b Additives: Calcium Nitrate, Zinc Oxide, Modified Corn Starch and (caustic compounds), accelerators and activators (Calcium and Zinc salts).

4. Pollution Prevention Opportunities:

A. MADESA:
4.1a Water: Use is minimal.
4.2a Solvents: Although loss are claimed to be less than 2%, the VOCs detected in the drum and can filling installation seem to indicate the percentage should be higher. This is confirmed by the method of handling:
- Reactors have hatches without gaskets.
- 50 liter drum filling device has a reservoir open to the air (no top cover). An improvised top made of particle board was not in place while the system was being used.
- 1 gallon cans were manually filled from 200 liter drum using a funnel. There are however commendable practices to prevent material/solvent losses:
- Solvent used in cleaning of reactors is fully recovered and reused in the next batch.
- Drums are recovered from purchaser and reused up to three times.

4.3a General:
- It is highly recommended that secondary containment be used in all tanks, reactors, and storage areas where there are possibilities of spillage.
- In the storage warehouse, strong oxidants should be stored separately from combustible or reactive chemicals. The areas should also be well marked and visible warning labels put in place.
- A copy of Material Safety data Sheets (MSDS) should be in place, i.e. in the warehouse, visible and easy to reach.

B. MADEGOM:
4.1b Water: Use is minimal.
4.2b Other additives: Nitric acid solution is dumped in the sewer after 5 days of use. Calcium Carbonate solution is also discarded. Both could neutralize each other. There is also a buffer ammonia solution used, but the tank does not have a cover, allowing fumes to escape. Some of the commendable practices:
- Rejects or off-spec material is sold for filling in rubber floor mats.
- Modified corn starch is collected in self-designed self-madefilters for reuse.

4.3b General:
- It is highly recommended that secondary containment be used in all tanks,

reactors, and storage areas where there are possibilities of spillage.

- In the storage warehouse, strong oxidants should be stored separately from combustible or reactive chemicals. The areas should also be well marked and visible warning labels put in place.
- A copy of Material Safety data Sheets (MSDS) should be in place, i.e. in the warehouse, visible and easy to reach.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **SORENA FOUNDRY**
SANTIAGO, CHILE

INDIVIDUALS MET: **Francisco Correa Prats, Anodes Division Chief**

EP3 TEAM: **William Bilkovich, Jorge Castillo**

Date of Visit: **March 23, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: The Sorena foundry centrifugally and sand-casts a wide variety of products from lead, zinc, brass and bronze alloys. A large machine shop finishes these castings. A secondary lead smelting operation using batteries as a lead source is also operated on the property. The facility is located in a mixed residential/industrial area of Santiago. The lead smelting operation works three shifts, five days per week with 14 employees. The bronze foundry and machine shop work two shifts, six days per week with a total of about 290 employees. Raw materials used include pure lead from Peru, lead from the on-site lead-smelting operation, copper, cadmium, arsenic, antimony, calcium/aluminum alloy, tin, silver and zinc. In cooperation with Royston, a British lead company, Sorena is developing a new product line of lead anodes for use in the ISA copper mining process. Instead of smelting copper ore, the ore is heap-leached with sulfuric acid and then extracted with an organic chelator. The copper is then recovered by electrowinning from solution using lead anodes and a copper-coated stainless steel cathode. Sorena expects this to be a significant part of their business in the near future. The EP3 team was questioned about the feasibility of machining beryllium/copper alloys. We pointed out the extreme caution needed with beryllium, a toxic and carcinogenic metal. One reason for Sorena exploring beryllium machining is the high cost of doing that machining in more developed countries. Customers are attempting to transfer beryllium machining to countries with less stringent environmental laws. The standard short visit questionnaire was given to Mr. Correa during the visit.

OBSERVATIONS: Sorena has at least seven open, un-vented containers of molten lead-containing alloys in the plant. Lead-bearing dust is spread throughout the entire facility. These dusts are also likely to be high in arsenic and cadmium. There is only one dust collector working in the facility. Zinc protoporphyrin (ZPP) testing is used to monitor for lead exposure, but only for workers in the secondary lead smelting area. Blood lead levels are taken every six months. Before ZPP testing was initiated, blood lead levels were taken every two months.

The EP3 team examined blood testing results and found blood lead levels reminiscent of an earlier

era in United States industrial history. The average reading is 45.9 micrograms per deciliter. The highest reading at the last test was 98 ug/dl. A reading of 40 ug/dl or above is cause for medical removal protection under the latest OSHA regulations. Workers must be removed from the source of lead exposure and tested periodically until blood levels fall. NIOSH has established a goal of setting permissible exposure levels which would be sufficient to insure that no worker's blood level exceeded 25 ug/dl. The action level of concern of children is 10 ug/dl. Most citizens not exposed to occupational lead and who live in housing built after the mid-1970s have levels of around 5 ug/dl.

Solid wastes generated by Sorena include foundry sands, battery casing waste and lead smelting slag. These wastes are sent to the municipal landfill in drums. Mr. Correa did not know what solid waste disposal costs were. Some non-contact cooling water is used in centrifugal casting. No testing has been done on the plant's sewer effluent. The area around the plant has apparently been tested for lead contamination in the past, but the results of that testing were not made clear during the visit. Because of the conditions found in the plant and the magnitude of the changes necessary to substantially change those conditions, the team did not pursue detailed process questions.

POLLUTION PREVENTION OPPORTUNITIES: There may be a some low and no cost savings available in non-contact cooling water and foundry sand recycling. Simple input materials control in the secondary smelting process can usually recover a bit more lead and yield a lower-lead slag.

RECOMMENDATIONS: Sorena is not a good candidate for a full P2 assessment. Their pollution prevention opportunities pale in comparison to the magnitude of the amount of pollution control that must be installed to work with the toxic materials that form the core of their business. An assessor would be exposed to unsafe conditions and generate a report that would give the impression that something had been done to improve the facility. Sadly, I think that the amount of work that would have to be done to improve Sorena is beyond the capabilities of the EP3 program. If there is an OSHA equivalent to the EP3 program, Sorena is a prime candidate for it. I gave Mauricio Roldan a copy of an American Foundryman's Association report on foundry waste streams. I suggest that Mauricio encourage Sorena to ask that association for a list of publications. In the last twenty years American foundries went through the kinds of changes that Sorena must now make. The association's publications could help Sorena make the transition to a safer work place if they are serious about doing so.

FOLLOW-UP ACTIVITIES: Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Delivers a copy of the American Foundryman's Association report on foundry wastes.

Within two weeks of the first letter:

1. Gather all requested information;

2. Encourages pursuit of information from the Association.

VISIT REPORT:	**Jorge Castillo**
INDUSTRY VISITED:	**SORENA FOUNDRY SANTIAGO, CHILE**
INDIVIDUALS MET:	**Francisco Correa Prats, Anodes Division Chief**
EP3 TEAM:	**William Bilkovich, Jorge Castillo**
Date of Visit:	**March 23, 1994**

SORENA produces mostly copper and lead alloys. Copper alloys are used for mining spare parts. Lead productions is about 100 tons/month, of which 60 are antimonial lead and 40 calcium lead alloys. Production includes anodes for electrolytic copper production, electrowinning, cathodic protection, etc. Also, some alloys are prepared as mother alloys for further dilution, such as cadmium copper, zinc-aluminum, and aluminum-silicon. Antimonial lead is recovered from used car batteries. These come to the industry with no acid. In the lead section work 14 people, from Monday through Friday, in 3 shifts. In the bronze section work 300 people, from Monday to Friday, in two shifts. Some workers have three shifts, also.

Blood lead testing was done every two months up to 1993. Now is done every six months. Sometimes a worker has to be sent to the hospital to be de-leaded. Occasionally the Ministry of health measures lead levels in air, inside the industry.

Prevention Actions:

Many safety practices has to be implemented, mainly to avoid metal poisoning of workers and surrounding environment.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **AGROINDUSTRIA HERMANOS PERINETTI, S.A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Azocar, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Agroindustria employs 65 workers on one shift, five days per week producing a variety of pickled vegetables. Cucumbers, onions and cabbage are grown on 40 hectares of Agroindustria's own land. Chiles are purchased from companies that produce chile seed. Most carrots are purchased on the open market. The factory is located on the outskirts of Santiago adjacent to farm fields. Effluent is discharged to a canal which is used for irrigation of those fields. Mr. Azocar took over management of the plant in April, 1993. He has initiated an extensive program of information gathering and plant modifications. The standard short visit questionnaire was given to Mr. Azocar.

OBSERVATIONS: Vegetables are cleaned and then soaked in successively stronger salt solutions in 218 open-topped tanks with a total capacity of 2.5 million liters. Most of those tanks are not under roofs. In some cases acetic and lactic acids are added during the pickling process. After an average residence time of 2 months, the pickled vegetable are washed in fresh water and packaged in vinegar with a small amount of sodium benzoate added. Yearly production of 1,900 metric tons of vegetables consumes 12,000 cubic meters of water, 245 MT of salt and 260 MT of 10.5 degree acetic acid.

Wastes produced by processing include vegetable wastes and salt water containing vegetable material. Each year 300 cubic meters of wet vegetable wastes are sent to the landfill. Smaller pieces and the organic material in pickling solutions are discharged to the canal with the rinse water used to prepare vegetables for packaging. The plant's effluent has not been tested for any of the parameters of concern. It can be expected that the plant's effluent to the canal has a pH of between 4 and 5 because of the organic acids in the pickling solutions. Chemical oxygen demand and BOD5 could be expected to be well above standards.

Based on water and salt consumption information, the sodium chloride content of the effluent can be calculated at between 20 and 25 grams per liter. At this time chloride discharge limits are not part of

Santiago's sewer standards. Salt, however, is a major cost for Agroindustria and its presence in the effluent will make biological treatment impossible. The very advantages of bacterial growth suppression that make salt pickling possible prevent the growth of organisms who could treat the organic content of the effluent. Salt costs about $14,000 per year. If it could be economically recovered, costs would be reduced and biological treatment of the effluent would be possible. There are three 50 cubic meter contiguous rectangular open-topped concrete tanks at the rear of the property. They are available for use for salt recovery or other effluent management needs.

Because of the small size of the piping that supplies the plant with City (EMOS) water, supply pressure is a problem for Agroindustria. To alleviate this problem, a number of tanks with a combined capacity of 60 cubic meters are filled with water overnight in preparation for use the next day. Water for cleaning is heated by direct steam injection into a drum of water. Mr. Azocar is in the process of making extensive changes to the facilities. One of these is the relocation of the diesel-powered boiler and the installation of a heat exchanger to heat water more efficiently and avoid the loss of treated boiler water. Other changes underway are tank rebuilding and the installation of new sewer piping. The concrete floor of the plant is extensively corroded by vinegar and salt solutions. Tile is being installed over the floors as they are repaired.

POLLUTION PREVENTION OPPORTUNITIES:

1. Water Use Reduction

   Water hoses do not have nozzles on the end. Water is shut off at valves located on the walls of the processing room. Shut-off nozzles on the working end of the hose would conserve water. One might think that water conservation is not a high priority because the effluent is already so high in salt and using less water would merely aggravate the problem. The amount of water, however, which would have to be added to the effluent to dilute it to a concentration in which treatment organisms could grow is so large that it would be prohibitively expensive to do so. It is better to capture the savings from reduced water use and work on the salt problem independently. The other advantage of water use reduction is that it helps to alleviate the water supply problem mentioned above.

2. Recovery of Salt

   The $14,000 value of the salt discarded each year makes it an attractive target for recovery. High salt concentrations in effluent is a problem common to all pickle processors. An initial search of the P2 literature did uncover a ready solution. More research is needed.

WORKER EXPOSURE ISSUES

No workers exposure issues were noticed during the visit.

RECOMMENDATIONS:

An information transfer candidate and possibly a standard PPDA candidate after that information has been supplied. Agroindustria's problem is very focused on the salt recovery question. Mr. Azocar speaks and reads English perfectly. EP3 should hire a P2 consultant familiar with the food industry to collect information on the salt-recovery methods being used by US pickle makers. This search should only take two days. I would recommend Stephanie Richardson or Roy Carawan for this task. Agroindustria is in the middle of major changes in its plant and equipment. They have a reasonable amount of space available for new processes. They have a new manager, married to the owner's daughter and with good access to upper management, who is committed to implementing change. Given the right information Mr. Azocar could solve his effluent problems and reduce costs. The question of whether Agroindustria is a standard PPDA candidate should be re-examined after they receive information on salt recovery.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;
2. Informs the facility of the availability of free pollution prevention training in the near future;
3. Informs the facility of the availability of a pollution prevention information clearing house;
4. Tells Mr. Azocar what EP3 intends to do to get him information on salt recovery.

Within two weeks of the first letter:

1. Gather all requested information;
2. Update Mr. Azocar on the results of EP3's literature search.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **AGROINDUSTRIA HERMANOS PERINETTI, S.A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Azocar, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

The industry processes all their own harvest and also buys carrots and other vegetables for processing. Main inputs, besides vegetables themselves, are NaCl, acetic acid and lactic acid. Production is in the range of 150 to 160 tons a month. Between May 1993 and March 1994 about 225 tons of salt 238 tons of acetic acid were used. All process water comes from EMOS distribution system. Water consumption is estimated as 1,000 m^3/month. Because of pressure problems water is fed and stored every night in tanks with a total capacity of about 60.000 m^3. After washing, vegetables are stored in 10% salt solution at pH less than 4 for about 1 month. Then are moved to a 16% salt solution. There are 218 tanks with a total capacity of 2.5 million liters. Vegetables settle in the solutions, filling about one half of the total liquid space. Most of the solutions are disposed off when the preparation processes is finished. Products are fully washed and stored in salt-less water at the end of the process, so a very small proportion of total salt remains in them. 60 to 65 people work in the industry, in one shift, from Monday to Friday.

Solid Wastes:

Solid wastes coming from the cleaning and peeling of vegetables have no apparent use because of its heavy salt content (could be mixed with salt free residues?). Solid waste production is about thirty 200 liters drums, or 6,000 liters a week.

Liquid Wastes:

Great volume of water with high content of sodium chloride, organic matter and organic acids. According to salt and water consumption between May 1993 and March 1994, sodium chloride concentration in the effluent should average 24 grams/liter. Effluent pH should be around 4 to 5. Also, a high BOD and COD should be expected. A problem with this kind of effluent is that the high salt level will not allow for an aerobic biological treatment and the high content of impurities will not allow salt removal by reverse osmosis. In any case, even if they were technically feasible, each of the mentioned treatments would be very expensive. Acid and saline wastes corrode floors and sewers.

Prevention Actions:

- Try to reuse solutions instead of discharging them.
- Handle liquid wastes without spilling on the floor.

VISIT REPORT: **Jorge David**

INDUSTRY VISITED: **AGROINDUSTRIA HERMANOS PERINETTI, S.A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Azocar, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 24, 1994**

OBSERVATIONS AND SUGGESTIONS

1. Industry: AGROINDUSTRIAS HP LTDA., Santiago, CHILE

2. Type of Process: Pickled vegetables. Total production = 160 MT/mo.
- Cucumbers
- Onions
- Chili
- Sauerkraut
- Carrots

3. Observations:

3.1 Water:

3.1.1 Supply: Metropolitan Network (EMOS).

3.1.2 Use: 1 000 m3 / month (estimated).

3.1.3 Discharged: Not measured or analyzed, but expected to contain common salt (Sodium Chloride) and organic load (BOD).

3.2 Raw Materials:

3.2.1 Vegetables: Own production plus eventual outside suppliers.

3.2.2 Salt: 225 MT/month.

3.2.3 Vinegar: 2 038 MT/month (2 485 liters @ 10.5°).

3.2.4 Other materials: Preservatives (Sodium Benzoate).

3.2.5 Other accessory materials: None.

4. Pollution Prevention Opportunities:

4.1 Water: Use is moderate, but may be improved.

Process: All water and salt used are discharged to sewer. Some research must be done to find an economically feasible system to recover both.

Cleanup:	Although not much hosing is done, use of brooms should be encouraged as a method of dry collection of residues from floors before washing. And hoses should be fitted with trigger valves/nozzles.
4.2 Vegetables:	Use for rejected material or vegetable residues would have to be investigated.
4.3 General:	Use of PVC piping in wastewater discharge ditches should prevent deterioration of same and of floors. Use of ceramic with silicon rubber type of seal should prevent deterioration of floors.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **FUNDICION AMAFUNKO**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Verdugo Caceres, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 25, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Amafunko is a cast iron foundry employing 65 workers on one shift, five days per week. Their product line includes water hydrants, manhole covers and valves and fittings for the water utility industry. There is also a machine shop to make brass and bronze parts for these products. Mr. Verdugo accepted the manager position about six months ago. He has been experimenting with changes in production methods and has found the workers to be cooperative in helping him make changes.

OBSERVATIONS: The furnace is operated only on Fridays for 6-7 hours producing 18-20 tons of iron per day. A typical load of input material consists of:

- Cast iron scrap, 200 kg
- Limestone, 8 kg
- Ferrosilicon, 2.5 kg
- Metallurgical coke, 11 kg
- Degassing agent, 0.5 kg

These ingredients are measured by volume (except for the degassing agent) into buckets, loaded into a hopper and transported to the top of the furnace. The hopper dumps through an open doorway and returns for another load. The door on the loading port is not closed while the furnace is operating. Slag from the furnace is tapped periodically throughout the melt. It is sent to the municipal landfill.

Molds and cores are laid on the floor of a large shed and the iron poured in small batches as it is tapped off the furnace. After the parts have cooled, they are removed from the molds and shot-blasted with large steel shot, 2 mm in diameter. This removes most of the sand which is separated when the shot is recycled. The rest of the molding sand is recycled by shoveling the sand off the floor and running it though screens. Core sand is shoveled up with the molding sand, but is not

recyclable because of the resins used to bind the cores. Large chunks of core sand are removed during the screening process and are discarded. Approximately 10 tons per month of sand are sent to the landfill. Smaller lumps of core sand go through the screen and wind up in the molding sand.

After shot blasting, flashing and sprues are removed by grinding. Grinding wheels are imported. Carborundum brand were being used during this visit. When the wheels have worn down, they are discarded. Depending upon the part, the next step is either painting or machining. Painting of small parts is done by dipping in a below-ground-level paint pit. Most parts are painted black (200 liters/month). Yellow and green account for the bulk of the rest of paint consumption (a total of 70 liters per month). Larger parts are painted with brushes. The composition of these paints is unknown. No MSDS with content information was available. It is likely the yellow and black paints contain lead and it is possible that the green contains cadmium. Empty paint cans are sent to the landfill.

Machining is done without liquid coolants. Iron turnings are discarded. Brass and bronze turnings are sold for scrap, but Mr. Verdugo is dissatisfied with the price he is being offered and is seeking other bidders. There is a carpentry shop to make molds and cores. The sawdust from it is discarded as solid waste.

The furnace emits substantial amounts of particulate matter. Envirotek, S.A. designed a bag house and exhaust gas cooling system to reduce PM emissions from the furnace. Exhaust gases first pass through a water curtain. The waste water from this device flows to a settling tank and then to the sewer system. The sludge is said to be removed from this tank weekly and sent to the landfill. The water from this cooling system is the only non-sanitary water discharge from the plant. It has not been tested for parameters of concern.

The exhaust gases next pass through 42 bags and then to the atmosphere. The bags are automatically cleared by air-powered vibrators. The system is said to have reduced emission from 150 mg/cubic meter to 86 mg/m^3. The target concentration is apparently 56 mg/m^3, the same as for boilers stacks. The measurement was taken at the exit of the bag house. In the recent past the bag house caught fire destroying all of the $42 bags at a total cost of $3,300.

The team noticed that the loading door is left open while the furnace is operating. Being at the top of a vertical furnace, the open door allows a substantial amount of smoke to be released, bypassing the bag house. Mr. Verdugo stated that Envirotek instructed him to keep the loading door open to allow for cooler air to be drawn into the system. From looking at the system in operation, it is clear that the effect of keeping the door open is to allow smoke to escape, bypassing the bag house entirely. The net effect is to reduce the amount of exhaust gas that the system must process, making it more likely that the gas exiting the bag house will meet standards and reducing the chance of burning the bags. The system seems to have been under-designed for the needs of the furnace.

Mr. Verdugo has been investigating the cost of converting to an electric arc furnace. He finds it hard to justify the $150,000 cost of a Spanish model with slightly less capacity than his present system.

POLLUTION PREVENTION OPPORTUNITIES:

1. Accurate Weighing of Input Materials

   Furnace charge components are measured by volume. Scrap iron, limestone and coke come in highly variable sized lumps. Slag production would be reduced and a higher yield of a more consistent product would be obtained is ingredients were weighed. The team suggested a weighing experiment to Mr. Verdugo.

2. Determine Paint Ingredients

   It should be determined whether the paints used at Amafunko contain RCRA metals. If they do, RCRA-metal free alternatives can be obtained for all three main colors. The yellow may be specified by municipalities. EP3 could help to convince government to change to lead-free paints.

3. Recycling of Grinding Wheels

   Grinding wheels too worn to be safely used (the hand gets too close to the work piece) still have some abrasive material left on them. In the US there are companies who buy used wheels, remove the abrasive and make new wheels from it. Santiago apparently has some grinding wheel manufacturers who might buy Amafunko's scrap wheels.

4. Reduce Worker Exposure to Paint Solvents

   When parts are dipped into the paint tank, workers must bend over with their head close to the tank and then lift the part. Aside from the back strain involved, the lifting motion naturally is accompanied by taking a breath at the very time that the workers head is in the strongest fumes. The pulley system that Mr. Verdugo suggested as a solution to both problems should be implemented. Designing a tighter-fitting lid and keeping it on the tank between painting jobs would reduce emissions.

5. Recycle Cast Iron Turnings

   Cast iron turnings from the machine shop are so small that, if they were loaded into the furnace, the draft would carry them out before they could become part of the melt. Simple pelletizing equipment can be purchased which would compress the turnings into larger, harder lumps that could be fed to the furnace. Cast iron, free of steel, which is what pelletized turnings would be costs $0.115 per kilogram. Amafunko purchases cast iron scrap mixed

with steel which must be sorted out before loading the furnace. That grade of iron costs only $0.057 per kilogram. The scrap for a week's production therefore costs about $900. The savings captured by recycling cast iron turnings are approximately $.06 per kg. If the pelletizer costs $5,000, 83 tons of iron turnings would have to be recycled to recover the cost. This is approximately one months production. At ten per cent metal removed as turnings, the payback would be approximately one year disregarding operating costs and avoided sorting costs. The weight of discarded iron turnings would have to be determined before the advantages of such a purchased could be evaluated.

WORKER EXPOSURE ISSUES

The two most exposed workers at Amafunko are the dip-painter and the person who tends the loading door on the furnace. Changing parts handling procedures would reduce the painter's exposure to solvent vapors. Determining what metals are present in paints and changing paints if necessary could reduce worker exposure to lead.

The worker who stands at the loading door of the furnace is continuously enveloped in fumes. He wears a mask and only works the position for two hours, but is still working in a poor environment. Members of the team inspected the operation of the loading door at the top of the furnace and can vouch for the adverse conditions. The door should be closed whenever charge is not being loaded. Envirotek should be asked to modify a system which can apparently only function by exposing workers and allowing uncontrolled releases to the atmosphere.

Workers do not consistently wear safety glasses. There is a poster available in the US that shows a close-up of an eye with a sliver of metal imbedded in it. EP3 should consider obtaining copies of the poster and overprinting it with a Spanish title (if it is not already available in Spanish).

RECOMMENDATIONS:

Amafunko is not a suitable candidate for a full scale P2 assessment. We made recommendations on which followup is necessary. The changes that can be made without much capital expenditure do not need much more data-gathering. EP3 could assist in finding recyclers for grinding wheels and brass scrap, locating a poster and connecting Amafunko with the publications of the American Foundryman's Association.

FOLLOW-UP ACTIVITIES:

Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Includes a list of the P2 opportunities outlined above and the worker exposure suggestions;

5. Delivers a copy of the American Foundryman's Association publication of foundry wastes.

Within two weeks of the first letter:

1. Gather all requested information;

2. Introduce Mr. Verdugo to Mr. Correa of the Sorena brass foundry to see if a recycling agreement for Amafunko's brass scrap can be arranged;

3. Give Mr. Verdugo a list of likely grinding wheel manufacturers in the Santiago area;

4. Determine whether Amafunko has identified paint components;

5. Decide whether to distribute an eye protection poster;

6. Inquire about the results of the proposed charge weighing experiment.

VISIT REPORT: **Jorge Castillo**

INDUSTRY VISITED: **FUNDICION AMAFUNKO**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Verdugo Caceres, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 25, 1994**

Process:

Plant melts iron mostly for hydrants, sewer man holes, and pipe fittings. 65 people work in one shift. Melting is done on Fridays and last about 6 hours, where 18 to 20 tons of cast iron are produced. Maximum capacity of the plant is about 25 tons in seven hours. Each batch uses about 200 kg of iron, 11 kg off coke, 8 kg of limestone, and 2,5 kg of ferrosilicium. Raw material are not dosed by weight, but by volume, so there are significant differences in the proportion of these materials that each load contains. About 0,5 kg of Degafort, a de-gasifying agent, are also used in each batch. Four samples of each batch are taken to determine its density, which should be between 23 and 26 grams/cm^3. Molds are made of sand. Inside molds for hollow pieces is made of a especial kind of sand and resin. Plain sand is reused after sifting. About 10 tons of make up sand are used every month. After ambient cooling, pieces are taken out of molds and shot blasted with steel beads. Beads size is about 2 mm. Manager thinks that the use of smaller beads would result in a better result. After shot blast excess material in pieces is removed with grinders. Pieces that do not require additional processing are then painted. Most of the pieces small enough to be dipped in a well with black paint are painted by immersion. Big pieces are brush painted. Fire hydrants are painted golden yellow. Some pieces that are finished in the mechanical shop and some hydraulically are tested for leaks. There is a carpentry shop were prototype forms for molds are prepared.

Air Emissions:

Furnace emissions pass through a 42 bags filter, built under recommendations of Envirotech, an environment consultancy and supply company. All 42 bags were burnt in one occasion because of an excessive temperature raise. Each bags has a cost of $ 35,000. At present there exists a cooling system for gases, consisting in a chamber where gases pass trough a continuous flow water deposit. Also, the door where material are fed into the furnace keeps open, apparently to get rid off some of the heat and alleviate the filtering system. Gases are released to the atmosphere through this opening without any kind of treatment. All emission monitoring has been done only in the bag filter outlet.

Isokinetic sampling shows that particulate matter in emissions has been lowered from 150 mg/m^3 in 1993 to 103 and then to a present concentration of 86 mg/m^3, according to the last measurement.

Solid Wastes:

Slag.
Used, not reusable sand, 10 tons/month. Resin sand is separated as lumps. Sand removed from pieces in cleaning machine.
Used grinders wheels.
Partially empty paint cans.
Iron and bronze chips at mechanical shop.

Safety:

Paint solvent breathing
Hydrants are painted golden yellow by SIPA (lead?)
Dust in carpentry shop. Needs a filtering or cyclone unit.
Normal risks in mechanical shop.

Liquid Wastes:

Effluent of combustion gas cooling system passes through a settling tank where, according to what the manager informed, solids are removed weekly. No effluent quality analysis have been done.

Possible Prevention Actions:

- Minimize input. Weight materials. To avoid rejection, this could be presented to workers as a means for measuring the amount of each input material. Try to classify material before use (do not mix iron and steel pieces)

- Find an use for used grinders wheels. Possibly local grind wheels manufacturers could interested in buying used wheels.

- Manager suggest use of a basket to dip pieces into painting well. This would reduce solvent breathing by the operator and would allow to recover dripping paint on the well, instead of outside, so reducing the amount of waste and the use of paint.

- Since bronze chips are made of a regular bronze kind and quality, try to sell it directly to SORENA or another industry which may have interest.

- Enforce further use of glasses and other safety equipment.

VISIT REPORT: **Jorge David**

INDUSTRY VISITED: **FUNDICION AMAFUNKO**
SANTIAGO, CHILE

INDIVIDUALS MET: **Pablo Verdugo Caceres, General Manager**

EP3 TEAM: **William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 25, 1994**

OBSERVATIONS AND SUGGESTIONS

1. **Industry:** FUNDICION AMAFUNCO - ACEVEDO Y CIA.LTDA., Santiago, CHILE.

2. **Type of Process:** Iron Foundry. Total production = 18 - 20 MT/mo.
   - Fire Hydrants
   - Sewer hatch tops.
   - Valves
   - Fittings
   - U-bends, etc.

   Machining of bronze and brass parts is also done at the facility.

3. **Observations:**

   3.1 Water:

   3.1.1 Supply: Metropolitan Network (EMOS).

   3.1.2 Use: Minimal.

   3.1.3 Discharged: Not measured or analyzed, but expected to contain dissolved salts (Calcium Sulphate, Carbonate), and some metals. Wastewaters are perhaps somewhat acidic, from cooling of gases from the smokestack.

   3.2 Raw Materials:

   3.2.1 Scrap Iron: Mixed parts and pieces of scrap and steel, from diverse suppliers and of variable shapes and density. Consumption = 20 - 25 MT/mo.

   3.2.2 Coke: Imported from Argentina. Consumption = 10 MT/mo. 3.2.3 Limestone: 5 MT/mo.

   3.2.4 Sand: 10 MT/mo.

   3.2.5 Other materials: Iron-Silicon alloy (120 Kg/mo), degassing agent, paints: - Black = 200 lt/mo; - Yellow + Green = 70 lt/mo.

4. Pollution Prevention Opportunities:

4.1 Water: Use is minimal.

4.2 Iron, Coke and Limestone: Measuring quantities by weighing will assure a consistent and appropriate smelting process, rather than measuring by volume, taking into consideration the highly variable shape of the scrap material. A selection of feedstock should be made to assure a consistent process. Keeping iron separate from other materials (steel, and unknown composition parts), and feeding the latter in a regulated manner will deliver a more controlled and even quality of product. In fact, quantities supposedly loaded per batch were declared as follows:

- Iron = 200 kilos
- Coke = 200 kilos
- Limestone = 8 kilos
- Fe Si = 2.5 kilos

but such quantities do not match monthly consumption rates.

4.3 General:

- Sand is being partially recycled. Research could be done or information obtained on types of sand (or suitable additives) that make it possible to recycle most sand.

- The dust filter system appears insufficient for the load, even though the limits for PM_{10} are met. It is subject to hot gases that burn the bags upon any excursions in the temperature.

- There is an abundant emission of gases from the loading hatch of the furnace because it is left open at all times, by recommendation from the manufacturer/designer of the filtering system, supposedly to allow cold air in and protect the filter, but heavy smoke is emitted from the port (positive pressure) so no air will enter into the pipes leading to the filter. It is only discharging gases to the atmosphere that would probably saturate and even burn the filter because its design would be insufficient.

- The furnace loading bin has two holes in the bottom to discharge dust so that it does not enter the furnace. However, the dust is spread from above over the workers area. There should be a simple device that would open the holes near the ground so that dust is discharged in one place without dispersion in the air.

- Painting many of the parts is done by dipping in a ditch with paint. The composition of the paint is unknown but aside from solvents, they may contain heavy metals. The worker doing the painting leans over to dip and then lift the parts, breathing fumes that may be toxic. The facility manager is considering the installation of a tackle and basket system to dip the parts from a suitable distance also minimizing the risk of back injury of the worker, and allowing for the paint to drip into the ditch, thus recovering the excess.

- Metal shavings or cuttings are discarded. It could be investigated whether they may be used elsewhere. Bronze/Brass shavings are collected to be sold as useful material.

- Spent or worn out grinding wheels may be recapped or sold as abrasive material to make new ones. An interested manufacturer must now be found locally.

- Sawdust from wood lathe in one of the workshops needs a collector system. A cyclone may be the best alternative.

VISIT REPORT: **William Bilkovich**

INDUSTRY VISITED: **QUIMICA INDUSTRIAL SPES S.A.**
SANTIAGO, CHILE

INDIVIDUALS MET: **Eugenio Gormaz D., General Manager**

EP3 TEAM: **Mauricio Roldán, William Bilkovich, Jorge Castillo, Jorge David**

Date of Visit: **March 30, 1994**

OBJECTIVE: Determine whether company is a suitable candidate for a Pollution Prevention Diagnostic Assessment. Determine whether recommendations made during short visits lead to pollution prevention changes.

BACKGROUND: Quimica Spes refines and converts fish oils into products for uses ranging from vitamins, omega-3 oils selling for $25,000 (US) per ton, to commodity-priced lead additives for PVC pipe. Their other principal product line is aluminum sulfate for the water treatment industry. It is made from kaolin and sulfuric acid. Fifty-two process workers are employed on two, six-day shifts. They are supported by 15 lab and quality control staff including three graduate chemists, one with a PhD from the University of Stuttgart. The general manager, Mr. Gormaz, has been with company for 24 years, working his way up to his present position from the maintenance shop.

OBSERVATIONS: The facilities are modern and well-maintained. Quimica Spes sells some of its products through Ciba Geigy, Sandoz and Hoechst. Those companies will soon require ISO 9000 certification. In preparation for the certification process, Quimica Spes discovered that, contrary to what they originally believed, recycling and close-looping of their processes saved rather than cost money. This analysis led them to re-analyze projects they had formerly rejected. The end result is a $400,000 pollution prevention modification program now underway at the plant. Programs include energy recovery, water recycling, oil recovery, chemical recovery, re-use of former by-products and some reduction in the use of toxic materials. Since this was a visit to search for a full PPDA assessment candidate and it was quickly apparent that Quimica Spes was very capable and willing to undertake P2 without EP3's assistance, the team decided to spend its time on-site encouraging and commenting on those changes instead of searching for more. A few observations are in order for comparison purposes to other Chilean facilities.

Water use is 2,400 cubic meters per month, 2,000 of which are used for one-pass cooling. Water is supplied by EMOS. No well water is used. The plant's effluent has only been tested for pH, temperature and conductivity. Conductivity and temperature were both higher than will be allowed when standards are imposed. No letter of notification of standards to be met has been received.

The Maestranza (Italian) boiler burns number 5 oil through a Finterm (also Italian) combustion-control system installed by Assler of Santiago. Particulate emissions have been measured at 52 mg/cubic meter, below the strictest standard set by air regulations. Quimica Spes is happy with the operation of the system. Before leaving Chile, EP3 recommended to Fernando Lopez that Proquindus contact Assler about examining such a system. Mr. Gormaz stated that they think that 30% of input energy to the boiler is wasted in steam leaks of all kinds, including traps.

POLLUTION PREVENTION OPPORTUNITIES: Quimica Spes has thought of enough opportunities on their own without needing help from EP3.

WORKER EXPOSURE ISSUES: There was some discussion of the use of soluble lead and barium salts and their effect on worker safety. Mr. Gormaz believes that the PVC and lubricant industries are not prepared to remove lead from their products at this time. Lead nitrate, a very soluble lead salt, is reacted with fatty acids from fish oils to form metallic salts. These soaps are used as high-pressure additives in lubricants, especially greases. The lead-based versions of these additives are no longer widely used in the US. Calcium, magnesium and strontium soaps have been developed as replacements. Quimica Spes uses about 4,000 kg/year of lead nitrate. If only 3 ten-thousandths of one percent of that lead finds its way into the plant's sewer effluent, the effluent will be too high in lead to meet the proposed standard. Mr. Gormaz is considering changing to a process that uses lead sulfate which is much less soluble than the nitrate. This might reduce, but not eliminate, the danger to workers. The processes which use lead and barium were not in operation during the visit, so the degree of exposure could not be determined. Given enough time, EP3 could contact lubricant, PVC and additive manufacturers in Chile and try to forge a consensus to eliminate the use of lead and barium-based additives before regulation makes it necessary.

RECOMMENDATIONS: Quimica Spes is not a candidate for a full PPDA. They have the motivation, expertise and capital to pursue extensive P2 modifications. I suggest that EP3 follow Quimica Spes's activities with the idea of documenting their change process and results. A case study made from this information could be used to encourage other Chilean industry to pursue P2. It might even be appropriate to create some sort of AMCHAM P2 award and give it to Quimica Spes if they actually accomplish what they have set out to do.

FOLLOW-UP ACTIVITIES: Within two days of the receipt of this report, prepare a thank you letter which also:

1. Requests the information in the standard visit questionnaire;

2. Informs the facility of the availability of free pollution prevention training in the near future;

3. Informs the facility of the availability of a pollution prevention information clearing house;

4. Congratulates Quimica Spes on the scope of their contemplated changes.

Within two weeks of the first letter:

1. Gather all requested information;

2. Contact Assler and enquire about combustion control systems.

3. Check to see that Proquindus has made contact with Assler.

4. Get a list of Assler customers in the Santiago area.

5. Collect emissions information from those customers and submit data to Eduardo Maal at EP3 headquarters for evaluation.

In July 1994 and at three-month intervals after that:

1. Contact Quimica Spes to check on the progress of their plant modifications;

2. When substantial progress has been made, encourage Mr Gormaz to help EP3 write a case study of their changes;

3. Discuss idea of AMCHAM P2 award with Steering Committee.

APPENDIX A

Short Visit Questionnaire

APPENDIX A
Short Visit Questionnaire

For each month the following information is requested:

Electricity
- Consumption in KWHr
- Cost of Consumption
- Demand in KW
- Cost of Demand
- Peak Hours in KW
- Cost of Peak Hours
- Total Cost of Electricity (including tax and fixed charges)

Boiler
- Type of Fuel Used
- Fuel Consumed
- Cost of Fuel Consumed
- Make-up Water Added

EMOS Water
- Consumption in Cubic Meters
- Cost of Consumption
- Excess Consumption (m^3)
- Cost of Excess Consumption
- Cost of Sewer Use
- Total Cost of EMOS Water (including tax and fixed charges)

Well Water (for each well)
- Is the Well Metered?
- Cubic Meters Pumped
- Nominal Rating of Pump (liters per minute)
- Current Draw of Pump (voltage and number of phases measured)
- Hours of Pumping per month
- Cost of Sewer Use for Well Water
- Sewer Use Assumed by EMOS (m^3)

Softened Water
- Softened Water Used
- Softener Salt Purchased
- Number of Regenerations

Production for Each Product

Effluent
- Volume
- Analysis Available?

Additional Facility Specific Materials or Resources

APPENDIX B

Comments on Survey Visits

APPENDIX B

Environmental Pollution Prevention Project
Comments on survey visits
Jorge Castillo

This document contains my impressions of the survey visits done to several industries and has been written upon request from William Bilkovich.

Short survey visits are very efficient in transmitting to industries managers the overall idea of EP3. I think most of the managers interviewed have really obtained a different idea of what they can do right away to reduce environmental impact produced in and by their plants. Also they have been sensibilized about what are the most important environmental or industrial hygiene problems, beyond just the compliance of standards and regulations. I believe many of them will dare to implement simple prevention actions they considered were not worth the effort.

Short survey visits are also a very good training opportunity for professionals that are beginners in pollution prevention. Work in close relation to experts, with the possibility of seeing actual examples of environmentally good or bad management, may be equivalent to many hours of theoretical lectures or papers reading.

The sequential visit to several different industries in a short period of time allows to find similarities and cross relations in the way that environmental problems are produced, and to recognize repeating behavioral patterns, so developing a especial perceptivity to detect potential prevention opportunities.

Finally, I think that the presence of foreign people in the interview with industries managers helps to get information about the industrial processes, input materials, production and other that could be considered confidential. Even though there is not an apparent rationale for this attitude it seems that the presence of foreign people in the interview guarantees that the information requested is actually needed and is not intended to be used for other purposes. Usually managers surprise when are inquired about production procedures more than about wastes themselves.

Jorge Castillo
Santiago, April 5, 1994