FINAL REPORT

MERCURY CONTROL TECHNOLOGY ASSESSMENT STUDY

Ray-O-Vac
Fennimore, Wisconsin

Preliminary Survey Report
for the Site Visit of
September 24, 1981

Contract No. 210-81-7107

September 1982

Submitted to:

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DISCLAIMER

Mention of company name or product in this report does not constitute endorsement by the National Institute for Occupational Safety and Health.

FOREWORD

A Control Technology Assessment (CTA) team consisting of members of the National Institute for Occupational Safety and Health (NIOSH) and Dynamac Corporation, Enviro Control Division met with representatives of Ray-O-Vac, a corporation of INCO Electro-Energy in Fennimore, Wisconsin on September 24, 1981 to conduct a preliminary survey on the techniques used to control worker exposure to mercury. Participants in the survey were:

Dynamac Corporation

Donato Telesca, Manager Engineering Department
Mr. David D'Orlando, Engineer
Mr. Robert Reisdorf, Industrial Hygienist

National Institute for Occupational Safety and Health (NIOSH)

Ms. Stephanie Spottswood, Associate Project Officer

Ray-O-Vac Corporation

Mr. Frank Clingan, Environmental Compliance Manager
Mr. Richard Goff, Environmental Program Manager
Mr. Michael Sulaver, Production Manager
Mr. Leroy Wilder, Associate Engineer
Mr. James Stivarius, Production Supervisor
Ms. Lola Stavonet, Plant Nurse
Mr. Richard Kopp, Chief Union Steward (Teamsters)

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INTRODUCTION

CONTRACT BACKGROUND

The Mercury Control Technology Assessment Study has been initiated to assess the current technology used to protect the worker from exposure to hazardous levels of mercury. The objective is to identify and evaluate the exemplary methods employed by industries in controlling worker exposure to elemental mercury and mercury compounds. A result of the study will be the publication of a comprehensive document describing the most effective means of controlling emissions and exposures. This report will be available to companies which handle mercury in order to transfer technology within the major mercury using industries. The study will also identify directions where additional research is necessary.

JUSTIFICATION FOR PRELIMINARY SURVEY

Preliminary surveys are intended to generate information about the control strategies used at various facilities and they will be used to determine where in-depth surveys will be conducted. This plant was selected for a preliminary survey because of the measures which the company has taken to reduce the mercury vapor levels associated with the production and use of battery gel.

SUMMARY OF INFORMATION

An opening meeting was held during which the objectives of the program were discussed. Information was obtained and a detailed process tour was given to the members of the survey team. The plant's engineering controls were reviewed and discussions were held on air and health monitoring, work practices, and personal protective equipment in effect at the facility.

PLANT DESCRIPTION

The products manufactured at the Fennimore, Wisconsin facility are C, D, and AA size alkaline round cells used for small electronics applications where longer battery life is desired.

The plant is an eleven year old corrugated steel building with cement floors. Continuous renovations have been made to the building since it was built in order to increase production and improve control of cathode mix particulates and mercury vapor. The entire plant occupies approximately 97,000 sq. feet. Work areas involving the use of mercury or mercury containing materials are the Gel Room, Scrap Room, and the center of the Production Assembly Lines where the gel is introduced to the battery can (Figure 1).

A total of 261 employees work at the Fennimore plant. There are a limited number of workers who may be exposed to mercury in the production areas. The number of workers in these job classifications are:

3 - line operators (first shift)
3 - line operators (second shift)
2 - Scrap Room workers (first shift)
3 - Gel Room workers (first shift)
1 - Gel Room worker (second shift)
1 - floating worker (second shift)
2 - supervisors (first shift)
1 - quality control worker (first shift)

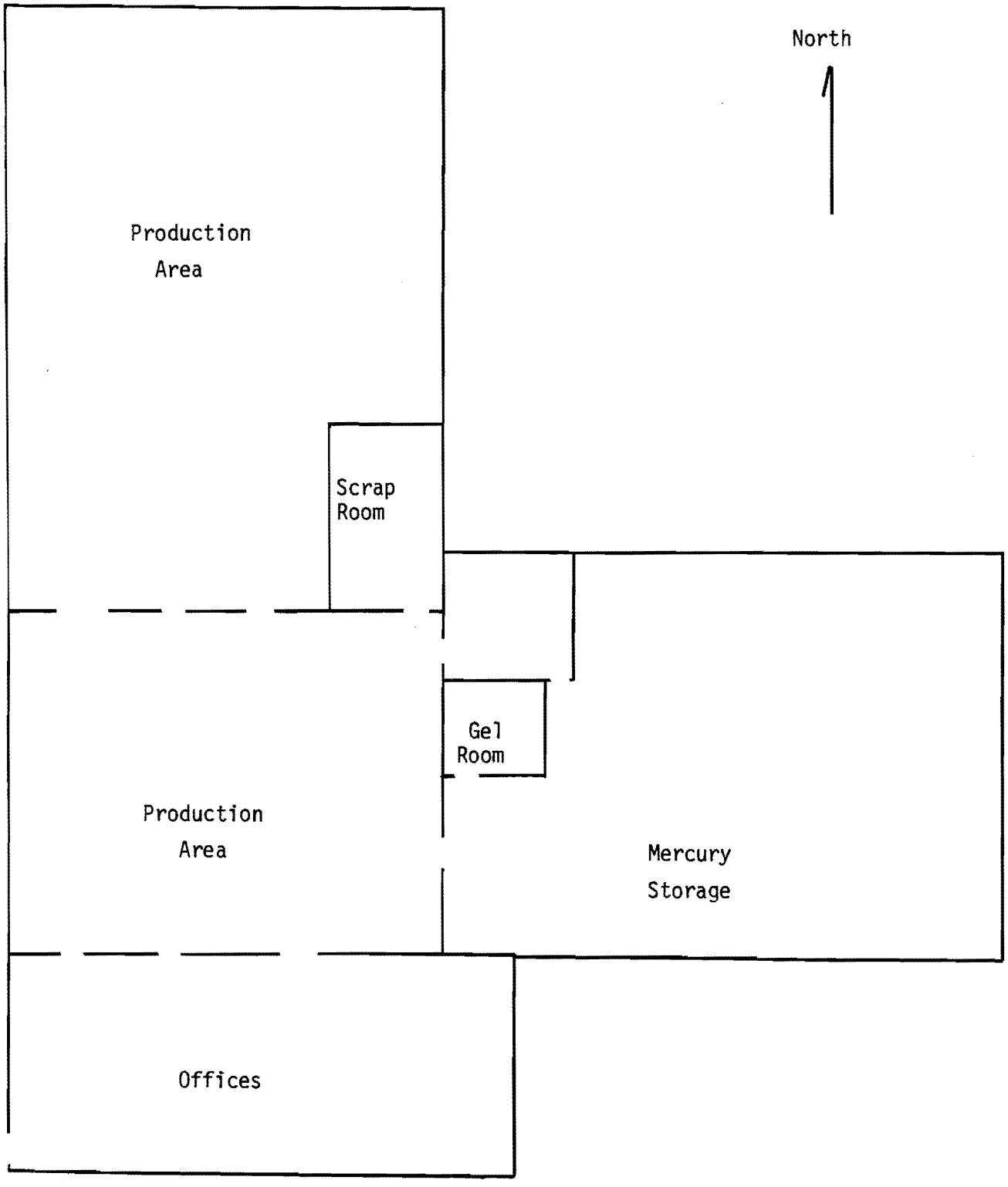

Figure 1. Ray-O-Vac Fennimore Plant Lay-out

PROCESS DESCRIPTION

GEL PRODUCTION

The anode for the alkaline battery is a zinc-mercury amalgam gel which is injected into the center of the cell. The mercury in the gel suppresses the generation of gas in the cell and it improves the discharge rate.

Anode gel containing mercury, zinc oxide and other ingredients is produced in the gel room. Liquid mercury is manually poured into a hold tank on the side of a fixed-shell planetary mixer blender. Dry ingredients (including zinc oxide are introduced into the blender through a chute; mercury is metered in from the hold tank. The blender is a sealed system.

After mixing, gel may be ground at the gel grinding station then placed in plastic cans, which are covered and sealed with tape to minimize mercury emission.

BATTERY ASSEMBLY

The cathode for the cell is a preformed, annular shaped, compacted mixture of manganese dioxide and other ingredients. Assembly of the cathode and the anode gel into a complete battery is achieved by a number of production steps. At one point in the process anode gel is inserted into the open cells, the cells are closed then transferred to the packaging area.

SCRAP RECLAMATION

Currently, all process scrap is sent to a regulated landfill site due to a lack of reclaimers.

MERCURY CONTROL STRATEGY

ENGINEERING CONTROLS

General Ventilation

The plant has a modified air system which plant representatives claim has significantly reduced mercury vapor levels. This air system is a general exhaust and supply system located throughout the Cell Assembly Area. It supplies dilution ventilation to the work areas where gel is dispensed into the cells. Detailed information on this system is not available.

Gel Room Ventilation

This system consists of an exhaust blower mounted on the roof of the room and three exhaust air intakes located inside of the room (Figure 2). One is an 18-inch (diameter) ceiling intake located above the Blending Area. The other two intakes are mounted at a gel grinding work station and at a sink area. This system creates a negative pressure in the room . Supply air flows through the opened doors into the Gel Room from the Storage Area on the south side. There is also a supply air vent which allows air to flow into the Gel Room from the Cell Assembly Area. Plant representatives report that the ventilation system in the Gel Room achieves 20 air changes per hour.

Gel Blender

A fixed shell blender was installed in October 1977 in order to improve the gel production process while controlling mercury vapor. It replaces a completely different multi-step process. Attributes of the system which contribute to the control of mercury vapor emission are:

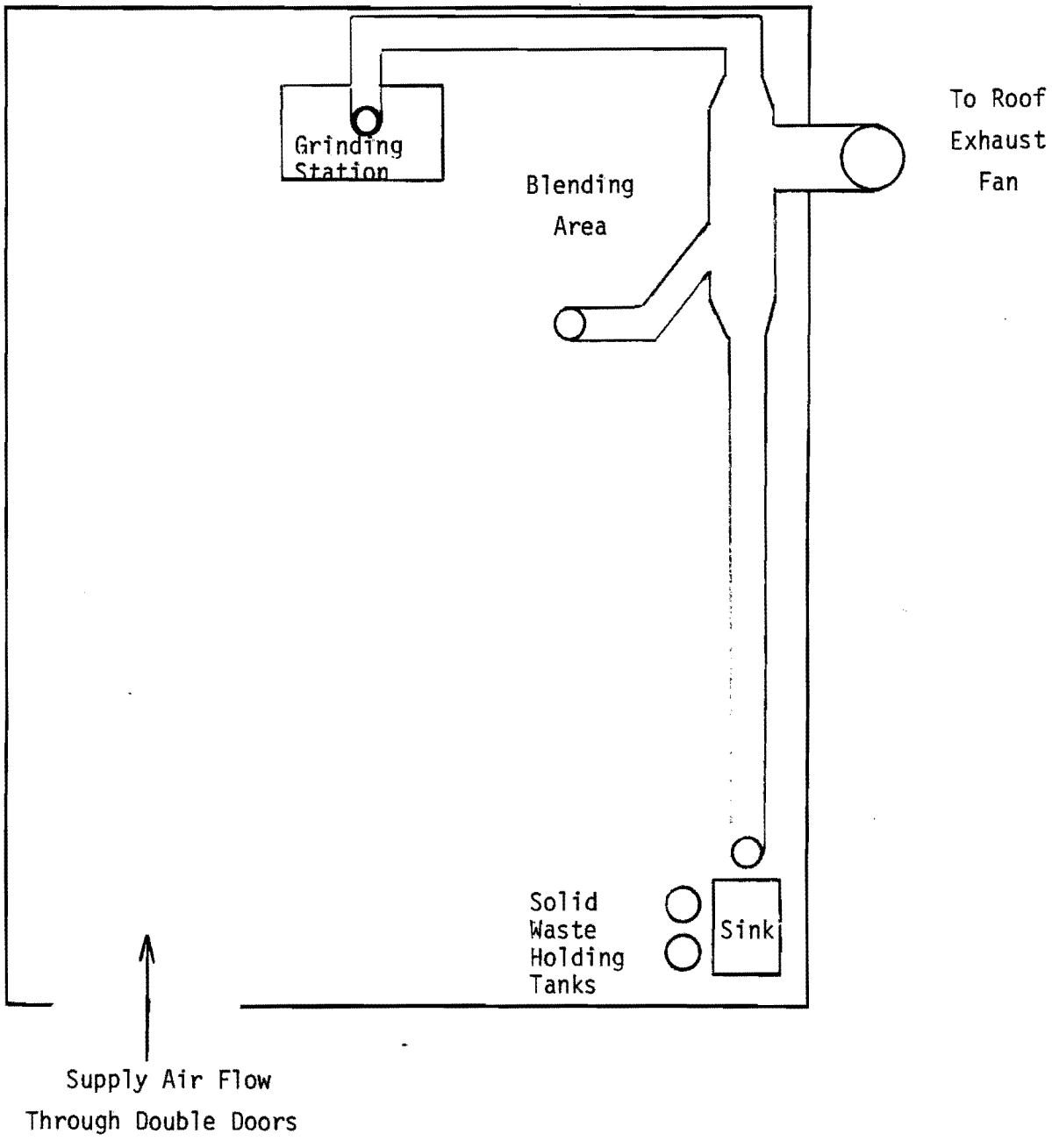

Figure 2. Gel Room Ventilation System

- The material addition system is closed.
- The connection between the blender top and the tub is sealed with an O-ring.
- The mixing operation is conducted in a sealed system.
- The exhaust air from the blender passes through a charcoal filter and is vented through the roof.

Gel Handling Controls

Anode Gel is kept covered in both transport containers and in gel dispensers. Transport containers are made of plastic and have covers which are sealed with tape. Reject cells containing openly exposed anode gel are discarded into buckets containing water. Scrap gel in the Gel Room is kept under water in closed drums set into the floor in front of the sink.

PERSONAL PROTECTIVE EQUIPMENT

In the Gel Room, where there is potential for exposure to both mercury vapor and liquid mercury, workers wear the following personal protective equipment:

- positive pressure, continuous mode, air-line respirators (Wilson Products)
- plastic face shield
- rubber gloves
- plastic sleeves
- rubber boots
- plastic aprons
- cloth coveralls (which are changed daily)

At the Cell Assembly Line gel loading stations, workers who handle the gel wear rubber gloves. The gloves are worn primarily for protection against potassium hydroxide, however they may also reduce dermal contact with mercury or mercury-zinc amalgam present in the gel.

WORK PRACTICES

Controls in effect at this facility to control worker exposure to mercury include the following:

In the Gel Room

- access is limited to three or four gel room workers (except when necessary for maintenance, etc.).
- job rotation is practiced so that a gel room worker spends two months working in the Gel Room and one month working elsewhere in the plant.
- workers alternate job duties daily, working one day at one operation and the next day at another operation because certain operations are considered to have a greater potential for exposure to mercury than others.
- floors are cleaned once per day using HgX^{R} a mercury vapor suppressant (available from Acton Associates).
- spills are cleaned up immediately using HgX.

In the Cell Assembly Areas

- spilled gel is picked up immediately.
- work stations are cleaned each shift using soap and water.
- lids must be kept on bins and gel dispensers.

Plant Wide

- smoking, eating or drinking are not permitted in production areas.
- employees are required to wash their hands before breaks and at end of the day.

MONITORING PROGRAMS

Biological Monitoring

The Biological Monitoring Program consists of periodic urinalysis for mercury. The following table shows the workers who are included in the program and the schedule by which they are monitored.

Biological Monitoring Program

Employee	Monitoring Schedule
4 Gel Room Workers	weekly
6 Cell Line Workers	every 3 months
2 Gel Room Supervisors	every 3-6 months
2 Scrap Room Workers	monthly
1 Quality Control Worker	every 6 months
Maintenance Worker	as needed

If the concentration of mercury in urine is at or above 0.2 mg/L a worker will be transferred to a low exposure area of the plant. The worker will be retested weekly until three successive sample results are below 0.05 mg/L. At that time the worker may be reinstated to his original position.

The biological monitoring program was initiated in 1975. At that time elevated (greater than 0.2 mg/L) urine-mercury levels were reported in Gel Room workers' samples. Major changes in the Gel Room since 1977 include the closed gel blending system and increased ventilation capacity (both in October 1977). Plant representatives believe that these changes have resulted in a reduction of worker exposure to mercury. Currently, there are no elevated urine-mercury concentrations in the Gel Room. Elevated urine-mercury concentrations are rarely reported elsewhere in the plant.

Air Contaminant Monitoring

Air sampling to determine the concentration of mercury vapor is conducted weekly using a mercury vapor detector (Jerome Model 401). Sampling is conducted in the Gel Room, Cell Assembly Area and Scrap Room. Personal monitoring is also conducted using Jerome Mercury Vapor Dosimeters.

Medical Program

Yearly physical examinations are given to employees of the Gel Room. The examination is directed at detecting signs or symptoms of mercury exposure and includes neurological tests, blood analysis and urine analysis.

CONCLUSIONS AND RECOMMENDATIONS

According to plant representatives, certain recently implemented control strategies have been effective in reducing worker exposure to mercury (as measured by urine-mercury analysis). These strategies include:

- a job rotation program for employees of the Gel Room in which employees work 2 months in the Gel Room and 1 month elsewhere in the plant. This program was initiated in 1978.
- the addition of the closed gel blender which began operation in 1977.
- increasing the ventilation capacity of the Gel Room.

It is recommended that an in-depth study not be conducted at this facility as sufficient information on mercury controls was obtained during the preliminary site visit.