

FINAL REPORT

MERCURY CONTROL TECHNOLOGY ASSESSMENT STUDY

Troy Chemical Corporation
Newark, New Jersey

Preliminary Survey Report
for the Site Visit of
October 15, 1981

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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 Mr. Milton Nowak of the Troy Chemical Corporation in Newark, New Jersey, on October 15, 1981, to conduct a preliminary survey on the techniques used to control worker exposure to mercury. Participants in the survey were:

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Alfred Amendola, Project Officer

Troy Chemical Corporation

Milton Nowak, Vice President of Production

The preliminary CTA was completed in 1 day. The study included a process tour and a review of mercury controls.

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INTRODUCTION

CONTRACT BACKGROUND

The Mercury Control Technology Assessment Study has been initiated to assess the current technology used to protect workers from exposure to mercury. The objective is to identify the 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 to control emissions and exposures. This report will be available to companies that handle mercury in order to transfer technology within the major mercury-using industries. The study will also identify areas where additional research is necessary.

JUSTIFICATION FOR SURVEY

Preliminary surveys are intended to generate information about the control strategies used at various facilities and are used to determine where indepth surveys will be conducted. The Troy Chemical Corporation plant was selected for a preliminary site visit because of the integrated work practices and engineering controls currently in use.

SUMMARY OF INFORMATION OBTAINED

An opening meeting was held during which the objectives of the program were discussed with Mr. Milton Nowak. The process was reviewed briefly, and a tour of the production facility was made. Engineering control details, work practices, and the biological monitoring program were reviewed.

PLANT DESCRIPTION

Troy Chemical Corporation, located in Newark, New Jersey, is a medium-sized chemical company that manufactures a variety of products, most of which are used as paint additives. Products include antiskin agents, bactericides, bodying agents, defoamers, dryers, mildewcides, preservatives, and wetting agents. Mercury-containing products manufactured at this facility are:

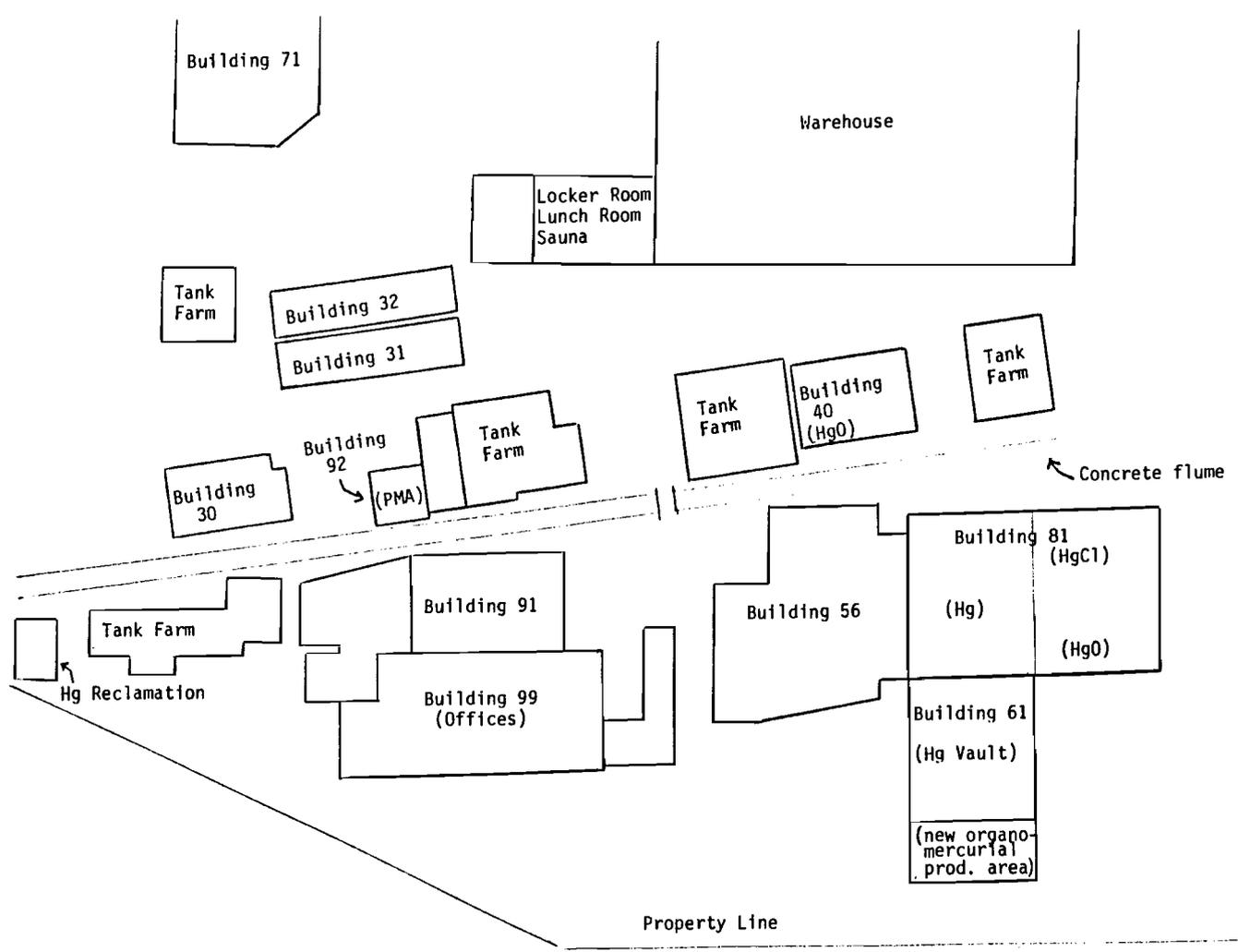
- Phenyl mercuric acetate (PMA) (liquid and powder)
- Phenyl mercuric oleate (PMO)
- Chlormethoxypropyl mercuric acetate (CMP Acetate)
- Mercurous chloride (Hg_2Cl_2)
- Mercuric chloride (HgCl_2)
- Mercuric oxide (HgO).

Production and mercury usage is about equally divided between the organic and inorganic compounds.

The Troy Plant, operating since 1956, consists of several major buildings, four of which are used for manufacturing mercurial compounds (Figure 1). The buildings that contain mercury production operations are:

- Building 40 - HgO production
- Building 61 - Mercury (Hg) storage/organomercurial production
- Building 81 - Hg handling/ HgCl_2 and Hg_2Cl_2 production/ HgO drying
- Building 92 - PMA grinding.

Building 61 was expanded in 1978 to accommodate the organomercurial manufacturing processes. Renovations have been underway since 1980 in an effort to locate all of the mercury production operations in one area (Buildings 61 and 81). Most of the buildings are constructed of corrugated steel.



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Figure 1. Troy Chemical Corporation Facility Layout.

Troy Chemical Corporation also has an outdoor mercury reclamation and purification facility consisting of two retorts and a still.

The plant operates three shifts per day, with maintenance conducted on the first shift. There are a total of 60 employees at the plant, 10 or 12 of whom are directly involved with mercurial compound production processes. Approximately 12 other employees work in the vicinity of the mercury production areas and therefore may be indirectly exposed.

PROCESS DESCRIPTIONS

RAW MERCURY HANDLING (Building 81)

Mercury arrives at the plant in 76-pound flasks on pallets. Flasks are stored in a vault in Building 62. The flasks are opened at a work station, emptied into a large container, and pumped to a proprietary purification process area. The processed high-grade mercury is sold directly. Flasks of mercury are also emptied into large, movable containers (2,000-pound capacity) at this work station. These containers are transferred to other parts of the plant for use in manufacturing mercury compounds.

MERCURIC/MERCUROUS CHLORIDE PRODUCTION (Building 81)

Mercuric/mercurous chloride is produced by a direct reaction between mercury and chlorine. Mercury is poured from 76-pound flasks into a hold tank that feeds the reactor. When mercury is allowed to flow into the reaction chamber, it burns with the chlorine gas. The combustion product is introduced to a precipitation unit where the mercuric or mercurous chloride settles out at the bottom. When the reaction and precipitation are complete, the dry product is raked out of the unit into plastic or fiber drums and the drums sealed.

MERCURIC OXIDE PRODUCTION (Building 40)

Mercury is transported to the HgO production area in the 2,000-pound containers. It is forced, by air pressure, out of the container and into a reactor containing nitric acid. Mercury dissolves in the nitric acid and forms mercuric nitrate as an intermediate product. The solution is pumped to a second reactor, where it reacts with caustic soda to form a mercuric oxide precipitate. This product is removed from the liquid by filtering. Wet mercuric oxide cake (which may be crystalline red oxide or powdered yellow oxide, depending on reaction parameters) is scooped out of the filters and into storage drums. The filtrate flows to the plant's mercury effluent treatment system.

Mercuric oxide is dried in ovens in Building 81. The resulting powder is emptied into an enclosed dumping station where the powder is vacuum fed to a grinder. After grinding, the powder is again moved by vacuum to a filling station where it is packaged into 50-pound fiber drums.

ORGANOMERCURIAL PRODUCTION (Building 62)

PMA and CMP Acetate are produced in the new organomercurial production area. PMA is produced in a proprietary process by reacting wet yellow mercuric oxide with acetic acid and benzene. CMP Acetate is produced by combining mercuric oxide, acetic acid, and an allyl compound.

Both products are made in the same reactor. Wet oxide is added to the reactor through a manhole at the top. The other ingredients are metered into the reactor. The liquid reaction product is pumped up to a Niagara Leaf filter where solid impurities are removed. Airborne mercury particulate is not considered to be at hazardous concentrations in this area because the mercuric oxide cake is moist and the reaction product is a liquid.

PMA is precipitated and then dried in a vacuum oven in Building 92. It is also ground and packaged in this building. After drying, the PMA is emptied into a 55-gallon drum and is hoisted up to the grinder loading platform. PMA is manually scooped out of the drum and loaded into the grinder. The ground product is emptied into a fiber drum and is sealed.

MERCURY RECLAMATION

Troy has an outdoor mercury reclamation facility consisting of retorts and a still. Mercury waste sludges generated at the plant are loaded into steel containers and put into the retorts. As the sludge is heated, mercury vapor flows up through a condenser. Condensed mercury falls into a collection chamber. Residual vapor in the effluent air that is not condensed flows through a scrubber where it is reacted with sodium hypochlorite. Solids resulting from the scrubbing process are settled out and returned to the retorts.

The impure mercury collected from the condenser is put into a hold tank and gravity fed to a direct-fired still. Vaporized mercury is again condensed, and the purified mercury flows into a receiver vessel containing 4 inches of water. Workers are not allowed in the area during the distillation process.

MERCURY CONTROL STRATEGY

ENGINEERING CONTROLS

Mercury Vapor Control

Mercury Vapor Adsorber--

A localized recirculating mercury vapor adsorber is situated adjacent to the mercury handling work station. The dimensions of the unit are 6 feet high by 1.5 feet deep by 2.5 feet wide. It contains a fan and an activated carbon filter. The intake vent for the unit is at floor level, and the exhaust vent is at the top. Both openings are approximately 30 inches wide by 6 inches high. The unit is operated during mercury filling operations.

HgCl₂/Hg₂Cl₂ Exhaust Hood--

An exhaust hood is situated over the door of the mercuric/mercurous chloride reactor in order to remove mercury vapor that is released when the door is opened. The face of the hood is approximately 30 inches wide by 6 inches deep. It leads to a roof exhaust fan and a caustic scrubber for chlorine gas and mercury vapor removal.

Mercury Vapor Condenser/Adsorber System--

Mercury vapor resulting from the reactions in producing organomercurials rise through a primary condenser and are refluxed to the reactor. Vapors that pass through the condenser rise into a secondary condenser where liquefied mercury settles into a hold tank. The hold tank is ventilated to a chilled condenser (-34.5 C) (-30 F) that routes additional condensed mercury back into the tank. Vapors passing through the final condensing stage flow into a Calgon Ventsorb filter, which is a 55-gallon drum containing charcoal filters. The entire system is essentially a tertiary condenser with a final scrubbing stage.

Mercury Particulate Control

Oxide Grinding and Packaging System--

The system for grinding and packaging mercuric oxide is closed and is operated under vacuum. This reduces mercury particulate escaping from flanges and valves and eliminates the need for manually transferring dry mercuric oxide between the grinding and packaging stations. Fine dust generated at the grinder is separated from the oxide product by a cyclone dust collector. The product-size oxide particles are spun to the outside of the cyclone and are channeled through a line to the packaging station. The fine dust falls through the center of the cyclone into a hopper on the bottom. It is emptied periodically into fiber drums lined with plastic bags. When emptying the collection hopper the plastic bag is taped around the bottom of the hopper so that when the valve is opened the dust is contained in the bag. The discharge of the vacuum pump, after going through another cyclone dust separator, is exhausted to the roof. The collected dust is removed once a week and is reprocessed through the grinder.

PMA Grinding Exhaust System--

The PMA Grinding Building (Building 92) has a local exhaust ventilation (LEV) system consisting of three 12-inch-diameter exhaust air takeoffs. One takeoff is adjacent to the station where the PMA is loaded into drums after drying. The second takeoff is an exhaust hood mounted on the side of the loading hopper for the grinder. The third takeoff is a semi-circular slot hood mounted at the edge of the drum loading stand for PMA coming off the grinder (Figure 2).

The ducts from these takeoffs connect to a blower that exhausts into a large, conical-shaped bag (Figure 3) mounted in an upper corner of the building. The bag collects the powder dispersed into the air at the three locations mentioned previously.

In addition to this filter bag, there are three additional filter bags used to collect fine powder generated from the grinder during its operation.

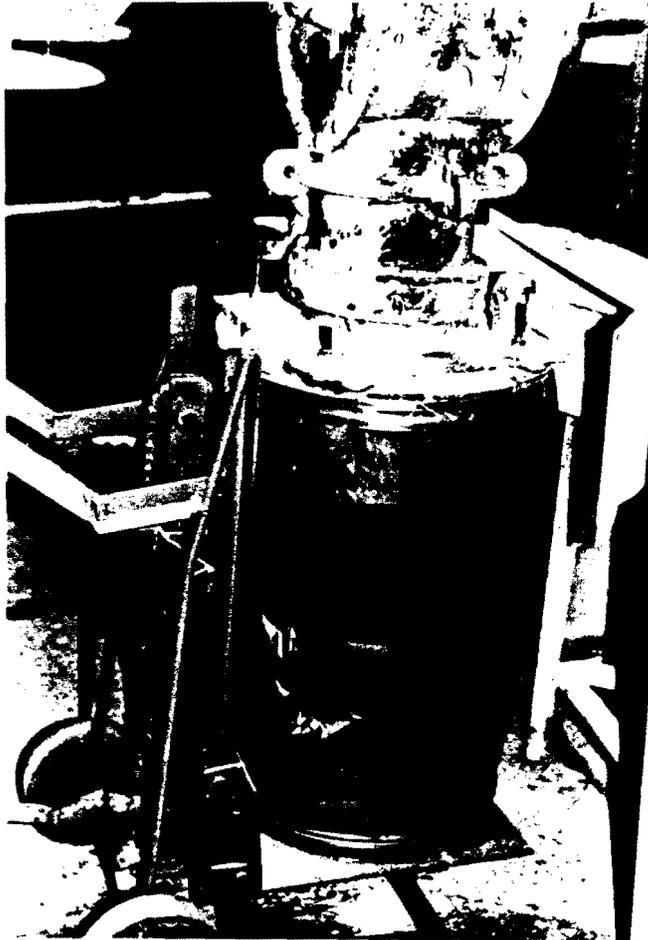


Figure 2. Exhaust Air Takeoff at Drum Loading Stand.



Figure 3. Filter Bag for Removing PMA from Exhaust Air.

These bags are part of a closed system above the grinder. After grinding is complete, this fine powder is allowed to flow down through the grinder into the drum being filled.

Spill Protection Pallets--

Metal pallets are used when forklifting mercury-containing chemicals. Every metal pallet has a 3-inch lip around its edges to help contain chemicals that may leak from drums.

PERSONAL PROTECTIVE EQUIPMENT

Respirators are worn by employees in all of the areas where mercury or mercury compounds are produced. Pulmosan Type CMH, No. 10792, full-facepiece, air-purifying cartridge respirators with hood (Figure 4) are worn by workers when handling PMA and HgO. These respirators are intended to protect against mercury vapor, which plant representatives have determined to be present in association with PMA and HgO production. They may also be effective in reducing exposure to PMA and HgO particulates. In other mercury exposure areas, 3M 8707 Disposable Mercury Vapor Respirators are used. These respirators are disposed of after approximately 8 hours of use.

Disposable coveralls made of Dupont Tyvek^R are used in the mercury compound production areas. These coveralls are disposed of after being used for several days. Work gloves and boots may also be worn if needed.

WORK PRACTICES

Practices in effect to control worker exposure to mercury at this facility are summarized as follows:

- Workers must wash their hands before breaks.
- Workers who handle PMA products or HgO are requested to shower at the end of the day. A locker room is provided that has a clean and dirty side so that work clothes may be separated from the employees' personal clothing.
- Company-supplied shoes and clothing may not be worn home.
- Spills of both liquid and powdered mercury compounds are cleaned using a vacuum cleaner (Hyvac Co.) followed by an application of a liquid mixture of calcium polysulfide. The area is then hosed down with water. HgX^R, a mercury vapor suppressant, was formerly used at this facility for cleaning mercury spills; however, plant representatives claim that the calcium polysulfide mixture achieves similar results at a lower cost.



Figure 4. Respirator with Hood.

MONITORING PROGRAMS

Biological Monitoring

The biological monitoring program at this facility consists of yearly urine and blood analyses for mercury. Employees who work in high-exposure areas, such as those in mixing and bagging operations, are monitored twice a year. Previously, samples were collected on a more frequent basis; however, the consulting occupational health physician recommended a less frequent sampling schedule because monitoring results showed generally low mercury levels.

If an employee's urine-mercury concentration is 0.30 milligrams/liter (mg/L) or higher, the employee is monitored on a more frequent basis. At the same time, plant representatives examine the existing workplace controls to try to determine the cause of the elevated concentration. A worker is relocated to a "no-exposure" area of the plant if indications of mercury intoxication also are present.

If an employee's blood-mercury concentration exceeds 10 micrograms per 100 milliliters (ug/100 ml) of whole blood, similar actions are taken. In addition, the employee undergoes a sauna treatment (Figure 5). The sauna treatment was initiated several years ago by the consulting physician in order to increase excretion (through perspiration) of mercury from an exposed employee. The physician considers the mercury in the bloodstream to be available for mobilization through the skin. Periodic perspiration analysis to determine the concentration of mercury is conducted during sauna treatment. Mercury concentrations in perspiration have been reported at up to 100 mg/L, indicating a potential for rapid excretion of mercury through this treatment.

Air Contaminant Monitoring

Air sampling to determine the concentration of mercury vapor is conducted using a Jerome Model 401 Mercury Vapor Detector. This instrument has a



Figure 5. Sauna.

sensitivity of 0.001 mg/m^3 and a range of $0.001\text{-}0.50 \text{ mg/m}^3$. Sampling to determine the concentration of particulate forms of mercury is not conducted at this facility.

OTHER PROGRAMS

The medical program at this facility is under the supervision of a consulting occupational health physician who is familiar with occupational exposure to mercury. The program includes yearly physical examinations with emphasis on the detection of mercurialism.

CONCLUSIONS AND RECOMMENDATIONS

Troy Chemical Corporation has employed several interesting controls in an attempt to control worker exposure to mercury vapor and particulates. The use of a sauna for removing mercury from the workers is a new approach that may reduce mercury levels in the body. The metal pallets are a logical approach to improving the storage of hazardous chemicals. Cyclones and filter bags have been installed for reducing mercury particulate concentrations in areas of potential exposure.

Troy should investigate the possibility of ventilating the oven doors on the retorts in the mercury reclamation facility because operators must unload containers of hot sludge from ovens containing mercury vapor.

It is recommended that an indepth survey not be made at this plant because adequate information on mercury control at this facility was obtained during the preliminary site visit.