INDUSTRIAL HYGIENE SURVEY

PORT ARTHUR WORKS

April, 1952
by Allan E. Dooley, Industrial Hygiene Engineer

This report summarizes the findings of a periodic industrial hygiene survey of certain operations at Port Arthur Works and contains recommendations based thereon. Findings and recommendations were discussed with local management at the conclusion of the survey. Recommendations are summarized below; detailed findings appear on subsequent pages.

SUMMARY OF RECOMMENDATIONS

Instrument Shop

1. Mercury should be handled so as to avoid spillage. If spills do occur, they should be cleaned up promptly. Good housekeeping should be maintained at all times.

2. The mercury dispenser in the storeroom should be placed in a metal or other impervious tray.

3. The mercury reservoir in the instrument shop should be mounted over a suitable tray.

Wax Laboratory

1. Block testing of wax, using mercury, should be done in an exhaust ventilated hood.

2. Non-amalgamating metal containers should be used in place of glass beakers.

3. The work table and hood should be free of all cracks and crevices and be provided with ledges.

4. Opening of envelopes should be done over an impervious tray.

5. Mercury containers should be kept covered and stored in the hood.

6. Good housekeeping should be maintained at all times. Dry sweeping should be prohibited.

7. Eating or storage of food in the test room should not be permitted

8. Waste materials should be discarded in a closed-top container and destroyed by burning.

9. Employes should practice good personal cleanliness.

Mass Spectrometer Laboratory

1. The wood tray supporting the glass equipment should be replaced by a metal tray or if this is impractical, the wood tray should be lined with an impervious material and made free of cracks and crevices.

Gas Analysis Laboratory

1. The linoleum table top on the No. 2 unit should be replaced by a new impervious top that is free of cracks and crevices.

General Laboratory

No recommendations.

Drum Welding - C. and C. Building

1. A welding booth with a face velocity of 150 f.p.m. should be provided in place of the present ineffective hoods (see attached sketch).

2. All welding of galvanized drums should be done in the booth.

Machine Shop - Metallizing

1. The hood on the metallizing lathe should be replaced by a more effective one having a face velocity of at least 200 f.p.m. (see attached sketch).

Machine Shop - Welding

1. A small hood should be attached to the hose on the portable collector for use in collecting arc welding fumes (see attached sketch).

Contact Filter Press Dumping

No recommendations.

Paint Shop

1. The red lead storage area should be thoroughly cleaned and kept clean thereafter.

2. All spills of red lead powder should be cleaned up promptly.

3. All such cleaning should be done by vacuum methods if practical. If dry sweeping is necessary, a respirator should be worn and no other persons should be in the area during such sweeping.

4. Respirators should be worn while handling bags of red lead and while dumping them into the ball mill.

5. Emptied red lead bags should be handled so as to avoid dissemination of dust. They should be kept in covered containers.

Anti-knock Laboratory - Tetraethyl Lead

1. Filling of TEL reservoirs from outside the hoods should be prohibited. All handling of TEL fluid should be done inside the hoods.

2. A supply of kerosine for removing TEL from the skin should be kept at the sink.

3. Rubber gloves should be kept at the hoods instead of being out of sight in a desk drawer.

Decanted Oil Exposures

1. All employes who may come in contact with decanted oil should be informed of the potential hazard and the recommended precautionary measures.

2. All employes exposed to decanted oil should be given annual physical examinations. Experience may indicate changes in frequency.

3. The value of good personal cleanliness should be continuously emphasized.

Chemical Storehouse

No recommendations.

Drum Filling Room - C. and C. Building

No recommendations.

INSTRUMENT SHOP - MERCURY EXPOSURES

Mercury was dispensed from the instrument shop storeroom by drawing off weighed amounts from the bottom of a steel reservoir having a capacity of about 2 flasks (152 lbs.). This dispensing apparatus was essentially two steel reservoirs; the upper one, which was connected to the lower, and larger one, by a short length of pipe containing a shut-off valve, actually serving as a funnel into which a flask of mercury could be poured. The open top of the upper reservoir, was covered with a plexiglas lid. The whole apparatus was mounted on an angle-iron frame which rested on a rough concrete floor.

Mercury was dispensed through a valve at the bottom of the lower reservoir into an aluminum pan resting on a "kitchen-type" scale. About two hundred pounds of mercury was dispensed monthly. Empty flasks were sent to the recovery yard as scrap, although a few were reported to be used as drip pans in the instrument shops.

Examination of the dispenser and the immediate area showed evidence of careless handling of mercury. Small globules were noticed all over the dispenser and the floor. Whether these droplets were the result of a few large spills or from many small spills could not be ascertained, although the latter is more likely the case. The area was reportedly cleaned once a week although from appearances, the cleaning was not thorough.

In addition to the handling of mercuryas described above, specially purified mercury in five-pound ceramic bottles was issued from time to time.

In the instrument shop itself, mercury was stored in a 76-pound flask on the edge of one of the work benches for use as shop supply. Mercury was obtained from the flask through a valve tapped into the side of the flask about a half-inch from the bottom. Here again, there was evidence of careless handling, as shown by a considerable number of droplets of mercury on the rough concrete floor directly beneath the valve on the flask as well as on the bench top. The instrument shop was reported to be cleaned daily.

While there was less evidence of mercury spillage at the work-benches and mounts where instruments were repaired, than was observed in instrument shops in certain other of our refineries, a considerable amount of mercury was noticed on the calibration stand.

Instruments in the field that need repairs were drained of mercury at the site, brought into the shop where they were steam cleaned and repaired. After repairs were completed, mercury from the shop supply was added and the instrument calibrated. After calibration, the mercury was removed from the instrument and returned to the shop supply and the instrument returned to the unit and the original mercury replaced.

While the large size of the storeroom and the instrument shop itself would seem to preclude the possibility of mercury poisoning under normal conditions, there is a possibility that hazardous concentrations

of mercury vapor and dust might occur because of the inadequate housekeeping with respect to mercury. Mercury is a cumulative poison, insidious in nature. Its vapor pressure is such that, at room temperature an atmosphere saturated with it can be many times over the maximum allowable concentration of 0.1 mg. per cubic meter of air.

Recommendations:

1. Mercury should be handled so as to avoid spillages. In the event that they do occur in spite of precautions, all spilled mercury should be cleaned up promptly. Good housekeeping should be maintained at all times.

2. The mercury dispenser in the storeroom should be placed in a non-amalgamating metal or other impervious tray with no crevices in which mercury can collect. If the bottom of this tray sloped somewhat to one corner, removal of any mercury from the tray would be simplified. If water is kept in the tray, volatilization of spilled mercury will be greatly reduced.

3. The mercury reservoir in the instrument shop should be mounted over a non-amalgamating metal or other impervious tray of sufficient size so that any mercury leaking through the valve will fall into the tray. The dispenser should not be any higher than is absolutely necessary to minimize the splashing of any mercury escaping from the valve.

WAX LABORATORY - MERCURY EXPOSURES

The block point test for paraffin wax being used involves the use of considerable amounts of mercury. Two pieces of paper, impregnated with the wax to be tested were placed in cellophane envelopes, mounted in wire frames and partly submerged in a vertical position in beakers containing mercury. The mercury was used to exert a uniform pressure against the wax-impregnated paper. Stoppers, each containing a vent hole and a thermometer, were then inserted in the beakers and the beakers placed in oil baths heated to 90°, 95°, 100°, 105°, and 110°F. After the mercury reached the desired temperature, the beakers were removed from the oil baths, allowed to cool to 70°F and the paper strips removed. Information on the properties of the wax was obtained by pulling apart the two strips of paper.

The oil baths were kept on a table top in the open in a rather small room which was kept at a temperature of 70°F by means of a small air-conditioning unit which reportedly recirculated about 90 per cent of the workroom air.

The floor of the wax laboratory was of small white hexagonal ceramic tiles. The work table had a metal top without a ledge. Considerable amounts of mercury were seen on the table top and to a lesser extent between the floor tiles.

This test method was about ready for publication, but it was reported that release had been held up pending the addition of a section pointing out that a mercury hazard was associated with the test. In this connection, a block test which does not require the use of mercury merits consideration. In this test the envelopes containing the wax-impregnated strips are placed on an aluminum plate having a built-in temperature gradient control, covered with a piece of sponge rubber to insure uniform pressure on the strips which is provided by a weight placed on the sponge rubber pad.

While no mercury determinations were made in the wax laboratory, confidential information from another laboratory showed that the mercury vapor concentration in the testroom ranged from 0.12 - 0.16 mg. of mercury per cubic meter of air when only two mercury beakers were being used in the lower temperature ranges. The air immediately above the beaker contained 0.80 - 1.10 mg. The air around the hands of the operator after removing strips from the envelopes showed 0.50 - 0.60 mg. per cubic meter. The maximum allowable concentration of mercury vapor is 0.1 mg. per cubic meter of air. These concentrations indicate that rigorous control of the mercury hazard is advisable.

TEX 13005

Recommendations:

1. All operations should be done in a hood having adjustable louvers at the top and bottom of the back side. The air velocity at the face of the hood should be at least 100 feet per minute. The air exhausted from the hood should be discharged to the outside. In this connection, the proposed use of U-tubes containing water seals on the mercury containers

would not be necessary. If make-up air is supplied direct to the hood from the outside during the test periods, the load on the air conditioning unit will be lessened.

2. Non-amalgamating metal containers should be used instead of glass beakers to minimize spillage of mercury due to container breakage.

3. The work table and hood should be provided with a ledge to prevent widespread scattering of any spilled mercury. All cracks and crevices in which mercury might collect should be filled.

4. Opening of the cellophane envelopes should be done over a tray. A photographic developing tray with a pouring spout to facilitate return of mercury to a container is suggested. An expanded metal sheet in the tray might be used as a working surface.

5. The mercury containers should be kept covered as much as possible and be stored in the hood. Keeping the containers in trays when not in use would help to localize any spills.

6. Good housekeeping should be maintained at all times. Dry sweeping of the floor should be prohibited.

7. Eating or storage of food in the block test room should not be permitted.

8. Used envelopes, test strips and any wiping rags should be disposed of in a closed top waste container. Such refuse should be destroyed by burning.

9. Good personal cleanliness on the part of the employes should be practiced.

IND. HYG. SURVEY
PAW, April, 1952 - A.D

MASS SPECTROMETER LAB - MERCURY EXPOSURES

A small amount of mercury was used in leveling bulbs for the infra-red gas analysis equipment. A few droplets of mercury were seen on the small wood tray which served as a support for the glass equipment of the unit. Some mercury was also observed on the floor back of the work bench which was a difficult place to keep clean. However, in general, housekeeping was good.

Recommendations:

1. The wood tray should be replaced by a metal tray or, if this is not practical, the wood tray should be lined with an impervious material and made free of cracks and crevices so as to facilitate complete clean-up of any spills.

IND. HYG. SURVEY
PAW, April, 1952 - AED

GAS ANALYSES LABORATORY - MERCURY EXPOSURES

Considerable amounts of mercury were used in the three rooms comprising the gas analyses laboratory. The employes in this division were well aware of the precautions for the safe handling of mercury and were doing a remarkable job of keeping these rooms mercury-free in spite of the poor conditions of the rooms. Flowers of sulfur were sprinkled on the floor from time to time in an attempt to control mercury vaporization. In room 3 of the gas analyses laboratory the mercury still was used from time to time to reclaim mercury. It was planned to replace this still by a smaller sized one which will be located in an exhaust ventilated hood. A linoleum table top on the No. 2 gas analyses unit in room 1 was very much in need of repair.

The three rooms which comprise the gas analyses laboratory have adequate general ventilation throughout most of the year and this fact, coupled with the care used by the employes in handling mercury, would appear to be adequate control of any hazard. The use of sulfur to eliminate the vaporization of mercury is not always as effective as commonly supposed. It is doubted that under existing conditions the use of sulfur contributes much to the control measures.

Recommendations:

1. The linoleum table top on the No. 2 gas analyses unit should be replaced by a new impervious top that is free of all cracks and crevices in which mercury might collect.

IND. HYG. SURVEY
PAW, April, 1952 - AEC

GENERAL LABORATORY - MERCURY EXPOSURES

Mercury was used in a number of places in the other divisions of the laboratory. However, the amounts used were fairly small, and the employes seemed well aware of its potential hazard. Water seals were used to cover the mercury in most of the leveling bulbs throughout the laboratory. Under normal conditions it is doubtful if any actual mercury hazard exists in these locations.

No recommendations.

DRUM WELDING - C. AND C. BUILDING

Leaky drums which were detected during the cleaning and reconditioning of drums on the fourth floor of the C. and C. building were repaired by means of acetylene welding torches. The welders had made complaints that the fumes produced during these welding operations were irritating to the nose and throat and had expressed apprehension as to the effects of these fumes on health. Most of the drums were made of steel, but a certain number were galvanized. It was the welding of galvanized drums particularly that gave rise to the complaints of nose and throat irritation. One employe in particular claimed that he had developed metal fume fever every time he welded galvanized drums, and for this reason, he was not assigned to galvanized welding.

Two small hoods, one used when welding leaky bungs and one used when welding bottom, top and side seams of galvanized drums, were an ineffective means of control of the zinc fumes produced during welding. Improper design of the hoods, coupled with the inadequate air flow partly due to the presence of at least 6 right angle turns in the duct, made these hoods ineffective.

It was observed that the fumes escaping from the bungs of steel drums were slightly irritating. The presence of small amounts of residual cleaning solutions in the seams might account for some of the irritating qualities of these fumes.

Welding of galvanized metal produces considerable quantities of zinc oxide fume which in its freshly formed state produces a condition commonly termed zinc chills or metal fume fever. The symptoms of this metal fume fever are chills and fever and some degree of nausea. The acute chill is generally preceded by a feeling of dryness in the throat, cough, and generally comes on a few hours after exposure, and it is a transitory condition. Zinc is not a poison in the true sense of the word and complete recovery occurs within a few days. A transitory immunity may develop and continue as long as the exposure to the fume continues, but may disappear within a few days after exposure terminates, such as over a weekend.

Recommendations:

1. The two ineffective hoods used for the welding of galvanized drums should be replaced by a welding booth having a face velocity of at least 150 ft. per minute. Such a booth 4 ft. wide and 6 1/2 ft. high with a depth to suit of 6 ft. or less would require 3,900 cubic feet of air flow per minute. A drawing of such a proposed booth is attached with this repor

2. All welding of galvanized drums should be done in this booth. The same booth could be used for welding of all drums if desired.

MACHINE SHOP - METALLIZING

An investigation of the metallizing operation was made because of complaints that fumes from this process were irritating to employes working in that end of the shop. The metals used were principally steel, both mild and stainless, monel, brass, aluminum, zinc and occasionally lead. Of these, brass, zinc and lead should be applied under good adequate exhaust ventilation for protection of the operator and persons working in the surrounding area.

The existing exhaust ventilation system was an entirely inadequate control device. It trapped only a small fraction of the metal particles. In effect it was a shallow hood about 18 by 24 inches in size and about 4 inches deep with a 2-inch slot along the bottom through which the air was exhausted to an air cleaner located about 10 feet away. The entire hood was mounted in the center of a metal plate about 4 by 6 feet in size, apparently intended to serve as a flange, and supported in a vertical plane about 2 feet back of the axis of the metallizing lathe. The ineffectiveness of the hood was further increased because it was not fitted tightly to the vertical plate, thereby permitting air to leak into the hood from the rear of the plate.

Actually what happened is that the metal particles left the metallizing gun with such high velocity that those not deposited on the work or deflected by the piece in the lathe literally bounced off the vertical plate or from the back of the shallow hood and consequently were not trapped by the exhaust system. An indication of the amount of metal escaping into the air from this operation was shown by the fact that the writer's glasses became visibly coated with a fine grayish-white fume in about 10 minutes while standing about 4 feet behind and about head level with the top of the vertical plate. In addition it was noticed that many small particles escaped through the narrow opening between the hood and the metal plate.

It is believed that the complaint is justifiable although not as serious as set forth and furthermore except when lead, zinc or brass are being used, is not a health hazard. Correction of this condition will result in removal of a nuisance and at times a health hazard.

Recommendations:

1. An adequate ventilation system should be installed on the metallizing lathe. The velocity across the face of the hood should be at least 200 feet per minute. The rear of the hood should be about 2 feet back of the axis of the lathe. A sketch showing essential features of suggested hood is included in this report.

MACHINE SHOP - WELDING

Although complaints in the machine shop were attributed to fumes from the metallizing process, it is believed that the electric welding processes adjacent to the metallizing lathe contributed in a slight degree to the condition. It is quite possible that, after the metallizing process has been controlled, the welding operation may occasion complaints from nearby employee. As a matter of fact, the crane operator commented on the fumes in this corner of the shop.

A propellor fan mounted on a pedestal was used to blow the welding fumes away from the welder. While welding fumes are not considered hazardous to health except when encountered in confined spaces, they can at times become a nuisance. A portable collector fitted with a flexible metal hose is available in the machine shop and if a small flanged hood were attached to the end of this hose, an effective local exhaust system for welding fumes would be available. In this event the use of the propellor fan, which is ordinarily not good practice, could be eliminated.

Recommendations:

1. A small hood of the type shown in the attached sketch should be attached to the flexible metal hose of the portable collector for use in removing welding fumes.

CONTACT FILTER PRESS DUMPING

Dust concentrations were determined during the dumping of the filter presses to estimate the effectiveness of the recently installed exhaust ventilation system. A concentration of 14 million particles per cubic foot of air was found to exist for the short period (3-5 minutes) when a press was being dumped. It was obvious, even without making a dust count, that conditions had been greatly improved by the installation of the dust collecting system. The employes expressed considerable satisfaction of the better conditions.

No recommendations.

PAINT SHOP

An inspection of the paint shop was made to evaluate exposures to red lead during paint mixing. The operation was not being done during the survey, but from observation and description of the process, it was evident that hazardous exposures to lead could occur.

The red lead was stored in paper bags in one corner of the shop. Quite a few bags had some powdered red lead on the outside and there was considerable lead spilled on the floor avidently from broken bags. The housekeeping in this section was inadequate, considering the toxic nature of lead.

In mixing paint, the necessary number of bags of red lead were dumped into a large ball mill by an employe who, according to reports, did not wear a respirator. The empty bags were put into drums with open tops for disposal by burning. The belief that no lead hazard existed because the paint mixing job was done intermittently and not necessarily by the same person each time should not be accepted, as a reason for not observing precautions.

Recommendations:

1. All red lead in the storage area of the paintshop should be cleaned up and the area kept clean thereafter.

2. All spills of red lead powder because of torn bags should be cleaned up promptly.

3. All cleaning should be done by vacuum methods if practical. If such cleaning can be done only by dry sweeping, the employe should be required to wear an approved type dust respirator and no other persons should be in the vicinity during the sweeping process unless wearing respirators.

4. Employes should be required to wear approved type respirators when handling bags of red lead and while dumping them into the ball mill.

5. Emptied red lead bags should be handled so as to avoid dissemination of dust both in the paint shop and during eventual disposal. They should be kept in covered containers.

ANTI-KNOCK LABORATORY - TETRAETHYL LEAD

The handling and use of tetraethyl lead fluid in the laboratory was in accordance with all pertinent instructions except for one operation which was not satisfactory.

A burette, used for dispensing TEL fluid, was connected by means of a glass U-tube to a small metal reservoir on a shelf near the top of an exhaust-ventilated hood. The approved method for refilling this reservoir is to disconnect the glass burette and U-tube, place the reservoir on the bottom of the hood and pour the TEL fluid into the reservoir from the stock bottle. The hood was sufficiently large to permit all of this to be done inside it. However, this procedure was not followed.

Instead, a small hole had been punched in the top of the hood directly above the filling hole of the reservoir so that a funnel could be inserted and the TEL fluid poured into the reservoir from the outside of the hood. The top of the hood was about 6 feet above the floor, which would make it necessary to stand on some object or reach very high while pouring the TEL fluid. This method presented an unnecessary exposure to TEL vapors and increased the chances of accidentally spilling the fluid.

Two other conditions, minor in nature, should be remedied. One was the absence of a supply of kerosine at the hood for removing any TEL that might get on the skin. Kerosine was said to be available around the laboratory, but speedy removal of TEL from the skin is essential, and valuable time could be lost in looking for a kerosine bottle "somewhere in the laboratory". The other was the storage of the rubber gloves in a desk drawer a short distance away where they might not be immediately accessible.

Recommendations:

1. The practice of filling the TEL reservoirs from outside the hoods should be prohibited. All handling of the TEL fluid should be done inside the hoods.

2. A supply of kerosine for the sole purpose of removing TEL from the skin should be kept at the sink next to the hood.

3. Rubber gloves should be kept at the hood in plain sight instead of in a desk drawer so they will be immediately available when needed.

DECANTED OIL EXPOSURES

In accordance with Mr. D. J. Hoose's letter of March 31, 1950, subject carcinogenicity, the information contained therein has been relayed to the various supervisors concerned. As yet this information has not been relayed to the employes who might be exposed to the decanted oil during the course of their work. The program for improving personal cleanliness is moving along very slowly. Some additional facilities have been installed. There is one wash basin on each of the two FCC units, and soap and towels have been made available at these locations.

Recommendations:

1. All employes who may come in contact with decanted oil should be informed by their supervisors of the potential hazard and the precautionary measures which should be observed.

2. All employes continually exposed to decanted oil should be given annual physical examinations including a thorough skin examination. *

3. The value of good personal cleanliness on the part of all employes should be continuously emphasized. Adequate facilities to permit good personal cleanliness should be provided at readily accessible locations.

* Experience may indicate changes in the frequency of such examinations.

CHEMICAL STOREHOUSE

Up to the present time the storage of chemicals, particularly those used as additives, has left much to be desired from the standpoint of possible health hazards. It is understood that a new chemical storehouse is being planned and that washing facilities will be more readily accessible in this new storehouse. The safety engineers at PAW are of the opinion that the facilities in the new storehouse will greatly aid in the prevention of possible health damage due to contact with chemicals and additives.

No recommendations.

DRUM FILLING ROOM - C. AND C. BUILDING

Employes working in this department have made complaints that the oil which was spilled on the floor during filling operations and which leaked from the drums was causing rapid destruction of the footwear and in a few cases foot irritation. In addition the oily floor increases the hazard of slipping.

In the past Stoddard's solvent was used for cleaning the oily floors, but its use was discontinued because of the obvious fire and explosion hazard. Kerosine is not a satisfactory substitute because of its low volatility. It is not possible to use detergents and hot water because of the possibility that water would corrode the base of the conveyor systems and make them inoperative. The ideal cleaning solvent for this purpose would be non-flammable, non-toxic, and non-corrosive to metal. In addition, not too expensive. It is doubtful if such material can be found, but this matter will be kept in mind. It might be possible to use an oil-absorbing powder in some areas of the drum filling room, but this does not seem to be suitable for general use.

No recommendations.