

# P107

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RECORD OF DISCUSSION OF THE CHEMICAL CONTAMINANTS FOUND IN THE ATMOSPHERE IN THE K-25 AND K-27 AREAS

KZ-

PLANT RECORDS DEPT.
CENTRAL FILES
REC. 68866
FILE
X-REF
X-REF

Date of Discussion:

September 24, 1946

Persons in Attendance:

Mr. J. H. Bull  
 Dr. M. J. Costello  
 Dr. A. G. Cranch  
 Dr. A. G. Kanner  
 Mr. H. H. Ketchum  
 Dr. R. H. Lafferty

The discussion was based on a paper entitled "Summary Report of the Nature of the Chemical Contaminants Found in the Atmosphere in the K-25, K-27, and Ferolve Areas", by H. H. Ketchum and R. H. Rainey of the Industrial Hygiene Section of the Works Laboratory. The different sections of the paper were discussed in the following order:

- Section C, Mercury
- Section D, Trichloroethylene
- Section E, Carbon Tetrachloride
- Section G, Hydrochloric Acid
- Section H, Ammonia
- Section I, Nitrous Fume
- Section J, Phosgene
- Section K, Combustibles
- Section F, Ercan 113
- Section L, Cadmium, Fluorocarbons, and Dust
- Section A, Uranium (T)
- Section B, Fluorine and Hydrofluoric Acid

REPORT NO.  
 KZ 3963

KZ 3963 4 A



KZ-3963

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 CG-PGD-4 K-25 Site Classification Office

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This document has been approved for release to the public by:

*Arvin J. Smith* 9/1/95  
 Technical Information Officer Date  
 Oak Ridge K-25 Site

Carbide and Carbon Chemicals Corporation Operating Contractor for the U.S. Atomic Energy Commission.

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REPORT NO.

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Section C- Mercury

Building 1024, Room 13 - Instrument Repair:

This room is fairly well ventilated in the summer with the doors and windows open. In the winter the ventilation is less adequate.

Line recorder tube racks are repaired in this room. This involves working with mercury diffusion pumps and traps containing mercury. Breakages result in spills of mercury on floor; sometimes hot mercury is spilled. One unplugging operation results in large quantities of mercury and mercury bearing salts being blown into the air. Now it is blown out of windows, previously it was blown out into the room.

There has been great improvement in the housekeeping over the last six months. It is standard practice to have catch basins on the floor under the tube racks to catch possible spills of mercury. Water is kept in the pans under the racks where the mercury is hot. Operators report mercury is sometimes carried into the office on shoes. Mercury spills have occurred throughout the whole room. No mercury could be found on the floor today. There were mercury spills and uncovered containers of mercury on a steel table, with a rim around the top to confine the spilled mercury. A vacuum cleaner is used by the operators on their own areas when spills occur. It has been recommended that the sink in the room not be used for mercury disposal, but the sink contained spilled mercury today. All personnel in the room are probably exposed to mercury.

The M.A.C. is well established at 0.1 mg. Hg. per cubic meter. The Pelsjaeff Method is used for analysis. This method is generally accepted as being accurate.

The Safety Department originally recommended that mercury transfer operations and mercury storage be limited to room 14 where a hood was to be provided. This location proved to be very inconvenient and so the recommendation has not been carried out. It would be more convenient to mark off a floor space in room 13 for the mercury transfer table and install a hood there. The hood would pull against the general room exhaust ventilation and might cause the mercury concentration to build up around the benches. It might be adequate to mark off an area for mercury handling, provide adequate handling equipment, keep the area clear to facilitate the clean-up of spills, and depend on general ventilation. If this were done, it seems likely that positive mercury analyses would seldom occur.

"Chemical traps" containing mercury and mercury bearing salts are being held until a number of them can be unplugged at one time. The procedure used to be to heat them and apply air pressure. They are

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now being washed with hot water before blowing. This operation should be performed under a hood; perhaps the same hood to be installed for the mercury transfer table.

It was agreed to recommend that an area be marked off for mercury storage and handling and that lateral exhaust ventilation be provided. All other equipment and operations to be kept out of this area. The mercury handling table should have a steel top with a flange around it and there should be a floor rim around the area.

The Safety Department suggested the possibility of placing the tube racks under hoods. It was agreed that general room ventilation would be satisfactory for the tube racks if catch pans were used. One source of mercury vapor is the sealing operation. Examples of analyses of samples taken when mercury diffusion pumps are being sealed into the tube racks:

- 1- Sample at point where sealing- 30 mgs. Hg./cu. meter (closer to operation than operator would have his face).
- 2- 0.4 mg. Hg./cu. meter where man normally breathes during this operation.

This is a short operation and is done only 5 to 10 times a week.

#### Medical Practices:

Operators are under observation. Should we include everyone in building 1024?

Operators come in every 4 weeks. The others should come in twice a year.

#### Medical Recheck:

An inspection of the gums for gingivitis.  
A history to see if he has insomnia, is nervous, or has less of appetite.  
Weight recording.  
Blood pressure recording.  
Complete blood count.  
Urine analysis for sugar and albumin (mercury content?)  
Microscopic test.  
Neurological examination- for tremors, changes in reflexes, etc.

Acute case of mercury poisoning: Caused by exposure to 40 to 60 mgs. for 8 hour day for 5 days a week, in from one to three months.

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**Chronic exposure:**

Sense of trouble - Tremor (coarse and jerky)

Change of personality (supervisor can help in this)

Person who was sociable, free and easy, suddenly becomes embarrassed, wants to work alone, gloomy and keeps to himself. Very easily irritated. The change is quite marked.

**Urine test:**

Analyses run in neighborhood of 1 or 2 mgs. per liter.

No difference between samples run at end of the day from spot sample in the morning. You get a pretty good line with spot samples at time of examination. There is a certain amount in most anybody working around mercury. All the urines may show some, but it is not definitely correlated with mercury poisoning.

Diagnosis has to be made on some other basis.

Mercury in the urine does not mean mercury poisoning, and it does not always show up in the urine when an individual has mercury poisoning.

**Question:** Should development of a test for the analysis of urine for mercury be pushed? Yes.

**Method of Testing:**

A colorimetric determination using dibutanaphthylthiocarbazone is being investigated.

Dr. Cranch will send us method of analysis they use.

**Medical Notes:**

The routine check-up calls for a brief history by the nurse: How is he feeling? Appetite? How does he sleep? Has he lost any time from work since he last appeared? Blood pressure, complete blood count and urine analysis for sugar and albumin are taken. (Chemical analysis for mercury?) If nurse finds any symptoms, employee is referred to doctor who makes a complete physical examination.

**Summary:**

Over a period of several months, exposures have been slightly higher than they should have been. There has been some improvement but there is need to go further.

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Recommendations:

- 1- Isolate mercury handling - mark off area where all mercury should be stored. Mercury transfers should be made in marked off area. Lateral ventilator should be installed. There should be rim around the table and rim on the floor to catch spills.
- 2- Provide hood for the chemical trap unplugging operation. Might be same ventilator set up for mercury handling.
- 3- Suggest consultation with Mr. Stam on hood design.
- 4- Continue method of supervisory rechecks of operators as is now being done.
- 5- Above medical examination for all employees in building 1024 twice a year.

There have been complaints of mercury being carried into the office. This has been seen. Watch to see if mercury is tracked. There are big spills occasionally. Could be caught in fabric of clothes. Should bear down on housekeeping and let shoe covers go. Vapor in the offices should be checked once in a while.

Building 1024, Room 4 - Instrument Repair:

About the same ventilation as in room 13. Fairly good ventilation in summer, fair in winter. Handle some, but less mercury than in room 13 and never hot. It is easy to control the housekeeping. There is no particular mercury hazard here.

Mercury Recovery - Conditioning Building Laboratory:

Air analyses showed over 0.1 mg. Hg./cu. meter all the time. The operation has been moved out of this laboratory.

Mercury Recovery - 1401 and 1301 Buildings:

Air analyses showed mercury contamination of the atmosphere. Moved out of both locations. The recovery equipment is going to be installed in 1303. The area may need additional ventilation. Area will have cement retaining wall. Operation is to be watched very carefully. Watch aerating operation and vacuum pump exhaust.

Building 1004-C, Rooms 261 and 265: Instrument Repair:

Analyses as high as 0.4 and 0.5 mg. Hg./cu. meter. Do not know exactly where it is coming from, although some progress made in locating sources. Some spills observed.

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Building 1004-C, Room 207:

Mercury diffusion pumps on apparatus. No positive analyses.  
Air conditioned building. Very occasional mercury spills.

Miscellaneous Process Area:

Diffusion pumps on Line Recorders break occasionally. Cleaned up promptly.

Summary:

Mercury handling operations in rooms 261 and 265 of building 1004-C should be investigated for possible installation of ventilating equipment.

Medical Notes:

Industrial re-checks not now being done for personnel outside of building 1024. Should be on list.

Include mercury recovery operators in set-up.

Section D, Trichloroethylene:

- Divides into three kinds of usage: 1- Degreasing tank in bldg. 1401.
- 2- Manual degreasing.
- 3- With dry ice in cold traps.

1- Degreasing Tank in Bldg. 1401:

70% of analyzes showed 100 p.p.m. or more during a significant portion of the time the analysis was being made.

ESTIMATE of exposure a few of the man experiences:

200 p.p.m. during 8 hours a day.

800 p.p.m. for 10 minutes at a time for 15 times a day. (This is too much, particularly if he has tendency to cardiac fibrillation. Trichloroethylene would accentuate this condition.)

The drying operation on large cylinders has been modified. Previously blew trichloroethylene out of cylinder into the room. Now attach a pipe to cylinder and blow vapor out doors. Very satisfactory if done properly.

Approximately same exposure at crane operators level as on ground. Vapors go to crane level readily.

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2- Manual Degreasing:

Some areas where manual degreasing is done have hoods. Some areas don't have hoods.

Pump Repair Shop- Building 1401:

Significant analyses in the area around the portable degreasing tank. Will continue to check. Hood over degreaser no advantage as is, because it vents out into room. Should be attached to exhaust system.

Air Conditioning Room, Building 1401:

Temporary job involving some repair work. Will not continue to use trichloroethylene.

Seal Shop - Building 1401:

Does not seem to be significant. Hood used draws very well.

Room 13- Building 1024- Instrument Repair:

Do little manual degreasing. Have good hood.

3- With Dry Ice in Cold Traps:

Line Recorder Stations in Process Area- Cold Traps:

Temperature of mixture is such that vapor pressure of trichloroethylene is not significant. Recharge traps about twice a shift, at which time operators are exposed to up to as much as 500 p.p.m. for a short period of time. Girls in stations thought we were checking on them and were filling traps more often than usual while we sampled.

Building 1301- Cold Traps:

Might possibly have been significant exposure, but discontinued use of trichloroethylene. Now using C-716. Suggested M.A.C. for C-716 - 5000 p.p.m. Army says might get some irritation from C-716 at that concentration. C-716 is very volatile.

Summary:

Two principle exposures to trichloroethylene:

- 1- Big degreasing tank in Building 1401.
- 2- Manual degreasing operations.

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There is no control of the issuance of trichloroethylene and it does not seem worthwhile to set up a control.

Method of Analysis:

Using Imperial Halide Gas Leak Detector. Dr. Cranch felt this method is generally acceptable in court. Is accurate in range 100-200 p.p.m. Not accurate in high concentrations. The new G. E. ultra violet analyzer now on order is to be calibrated for trichloroethylene as well as mercury.

Medical:

Dr. Kammer says he has seen massive exposures to trichloroethylene here involving quite a few men for quite a length of time. Tends to confirm previous impression that trichloroethylene is not very toxic. It does produce narcosis. Dr. Cranch told of two cases of bad hearts aggravated by repeated exposure to trichloroethylene. They had abnormal heart conditions to start with and trichloroethylene pushed them over.

Conclusions:

1- Dr. Cranch stated that trichloroethylene does have effect on cardiac fibrillation. Dr. Kammer says he might have become caloused on the subject but he believes trichloroethylene is relatively harmless; about the same as gasoline vapors but a little more toxic.

2- Tendency to cause dermatitis through defatting. Usually clears up pretty well. Is not dangerous when absorbed through the skin.

3- Men handling trichloroethylene should be checked over thoroughly and more safeguards provided. Check physical conditions closely. Vapor should be used instead of straight stream of trichloroethylene. Straight stream should be eliminated as much as possible or else use it in bottom of tank. Operators should be educated to do this. In cleaning tanks, operators should be provided with air line respirator and should have a harness and watcher.

4- It is safe to take down "No Smoking" signs. Considerable work shows smoking in trichloroethylene vapor does not produce significant amounts of phosgene.

5- Mr. Stan should come down and advise on ventilating system in exposure areas. The data shows the ventilating system at the 1401 building degreasing tank has become progressively less effective.

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Medical Control:

Nobody with organic heart disease or hypertension should work in the area. There is an addiction.

Never give adrenalin to a person overcome by trichloroethylene. Treat for narcosis- let alone.

Section E-: Carbon tetrachloride:

To the best of our knowledge carbon tetrachloride is no longer used for manual degreasing jobs. It is not used in any normal operation of the process areas.

Suggested Elimination of Issuance: Not to be used except when approved by the Safety Department. Not to be used as a cleaner in the plant. Limit storage of carbon tetrachloride to laboratory storage stock.

Carbon tetrachloride vapor must be kept below 100 p.p.m.

Section G-: Hydrochloric Acid:

Building 1101- Acid Bath H-304-B:

Characteristic condition is that visible vapor comes off east side of bath.

Usual analysis, 20 to 25 p.p.m. on east side of tank. Have run as high as 110 p.p.m. Metal containers in area picked up a chloride coating over one weekend.

Crane Operator Level- Acid vapor does not get there in any appreciable quantity.

The acid vapor is visible and the men on the ground or in the cranes try to stay out of it.

Recommendation: Present ventilating system on bath H-304-B should be repaired.

Building 1101- Acid Bath H-305:

Causes no appreciable contamination of the area. The ventilator on this tank has been rebuilt recently.

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Building 1303:

Hydrochloric acid used for recovery and development operations.

Does not appear to constitute a hazard. This area is constantly watched due to the miscellaneous and changing nature of the operations.

Toxicology:

Pulmonary edema might result occasionally. There is no eight hour exposure. Exposure probably 15 minutes at a time, a few times a day. There is a very practical hazard.

Medical:

There is no particular danger if exposure is below that which will cause pulmonary edema. No chronic effect for lesser exposure.

Section II-: Ammonia:

Building 1303:

Ammonia used for recovery and development operations.

Occasionally, analyses have been as high as 350 p.p.m. Ammonia has adequate warning properties. The area is watched closely.

Hazard: Cylinder of anhydrous ammonia in use. Safety Department will continue to watch this.

Refrigeration Systems:

Do have large amount of ammonia in refrigeration plants. No chronic exposure. Possibility of serious accident if large quantities escaped.

Section I-: Nitrous Fume:

Building 1303:

Have used hot nitric acid to clean a large number of nickel plates. Dens only occasionally. Hood for job is very effective. If hood should fail danger would be great. Keep track closely. Combination exposure with other things that make it a little more dangerous. We detect 10 p.p.m. If exceed 50 p.p.m. would get into difficulty. American Standard Association has adopted 25. Working on assumption there

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is no adequate warning. Concentration of brown color is dangerous.

Watch for spills of nitric acid on wood surfaces. Use sand to clean up, not sandust.

Building 1004-D, Room 8:

Laboratory operations requiring heating nitric acid on hot plates.

Should be watched closely, as hood is known to operate ineffectively. Work order to improve hood has been placed.

Section J-: Phosgene:

Chlorine type cylinders were received from government arsenals. Found some had not been decontaminated. Routine check made of every cylinder received in plant. 5% showed presence of phosgene. Contaminated cylinder is given a special decontamination treatment before being put through regular cleaning treatment. Take due precaution when phosgene present. Should watch closely.

Section K-: Combustibles:

Davis Vapometer used.

Never have found combustible atmosphere.

Section F-: Freon 113

312 Section- Pump Repair Shop:

Used for manual degreasing. Have occasionally found analyses as high as 500 p.p.m. Not considered very hazardous, although it has high vapor pressure. Have not found M.A.C. for Freon 113 in available literature.

Section L-: Miscellaneous Contaminants

Cadmium:

Sampled in Cold Trap Room during Cadmium spray coating of traps.

All personnel had fresh air masks. Recorded high concentration of cadmium. Room isolated from rest of area. Blue green haze remains in the air for hours. We have determined on laboratory basis that silver soldering operations should be checked for cadmium and field work is in progress.

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Fluorocarbons: (C-316 and C-716)

Is adequately semi-quantitative or quantitative<sup>METHOD OF</sup> analysts. Is carefully handled because of the cost. Used as coolant in process area. Might become problem at a later date as cost goes down and other uses found for it.

Dust Counting:

A "dust" count survey is in progress in the 1401 building carpenter shop. Doubt if dust is much of a problem except that in the carpenter shop the air filters are being clogged up with sawdust. No health problem. No medical data.

Section A-: Uranium

Expected this to be a more serious hazard than it has turned out to be.

Three general groupings of possible sources of air contamination:

1- Normal operations of the plant:

Building 131- Raw product is fed into plant.

89% of air samples showed no uranium.

When sizeable leaks occur the personnel are evacuated from the area.

Building 631- Withdrawal of depleted material.

No uranium in 92% of analyses.

Building 306-7- Final product withdrawal.

Will give more thorough coverage in the future.

No valve connections on withdrawal cylinder. Depend on freezing products down with liquid nitrogen. Visible quantities escape into the atmosphere occasionally. Operation performed intermittently.

Building 413-

Very little coverage. Same type of operation as buildings 631 and 131.

Building 601- No longer sampled. No significant quantities of uranium were found in the atmosphere.

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2- Repair work or special operations involving opening up equipment in process area:

We occasionally find analyses of 0.2 mg. /cu. meter or greater during short periods of time while this type of operation is performed. Does not represent normal operating conditions. Such exposures are accidental and very infrequent for any one operator.

3- Miscellaneous T Recovery and Developments

Buildings 1301, 1302 and to some extent in bldg. 1401.

Special operations do result in occasional release of significant quantities of T into the atmosphere. The nature of the operations varies from day to day and from week to week. They are regularly observed in all three areas. One potentially hazardous type of operation involves handling dry T compounds, principally  $T_2O_8$  and ammonium diuranate and carbon contaminated with  $TO_2F_2$ .  $T_2O_8$  is the least hazardous of the three as it has very low solubility in the body acids. Ammonium diuranate is soluble in body acids but not in water.  $TO_2F_2$  is water soluble. The visible warning properties of C-616 are considered adequate. Visible hydrolysis product appears in atmosphere containing a normal amount of water vapor. Handling dry dust might result in hazardous quantities getting into air without being noticed.

Analytical Method:

The fluorescence test used is capable of detecting <sup>NAUCH</sup> smaller quantities of T than the M.A.C of 0.15 to 0.2 mg. per cu. meter.

Medical Notes:

So far as is known, as a result of the work at Rochester, the only damage done by T materials, as such, is kidney disease. Give full supervision to people who come in. Get complete blood count as indication of general health level. Did do a chemical analysis of urine for T. Even after massive exposure essentially all T is excreted within 2 to 6 hours. No point in doing T analysis for routine measure. When people report exposure as a result of equipment break, we do send urine for T analysis. Occasionally will find in urine. Elimination is rapid.

Section B-3 F<sub>2</sub> and HF

The Alizarin Sulphonate titrations used as a test will detect any fluoride which ionizes in water. Many samples represent mixtures of HF, F<sub>2</sub> or OF<sub>2</sub>.

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Building 1301:

Fluorine is made here by electrolysis. Normally there is no appreciable atmosphere contamination. Occasionally it is necessary to change the electrodes in the cells. This results in high concentrations of HF. The operators wear protective equipment and the work is done in ventilated cells. Does not get into the general atmosphere of the building. The  $F_2$  disposal unit has been known to fail to function. In such cases appreciable quantities of different fluorides are emitted from it. In all cases warning properties are very adequate.

Building 1303:

Do recovery and development operations which might involve releasing either fluorine or HF into the atmosphere. We have found no significant atmosphere contamination.

Building 1401:

About the same kind of work as in building 1303. Once were using cobalt trifluoride powder. Handled it in such a way that 12.5 mg.  $CoF_3$  per cu. meter was reported. This would be a serious hazard if handled very often.  $CoF_3$  hydrolyzes readily giving HF.

Process Area- Field Conditioning:

A series of air analyses was made around field conditioning crews using  $F_2$ . Most analyses showed less than 0.1 p.p.m. Quantities higher than that were experienced occasionally by the members of the crew. Exposures were for very short periods of time. Experience shows that the average person will detect about 0.1 p.p.m. by [REDACTED], hence the warning properties are adequate. odor

Toxicology of chronic exposure: Bone changes.

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