

Safety - Physical Hazards

MONSANTO CHEMICAL COMPANY

Location : Texas City, Texas

cc: Plant Manager's
Safety Board

Date : August 15, 1963

Carl H. Duhon
J. W. Kongable

Subject : MERCURIC SALT EXPOSURE

To : W. R. Nisbet

For the past several months, VCM operating and maintenance supervision with the assistance of the safety department have studied the exposure of personnel to mercuric salts in the handling of catalyst and maintenance of reactors in VCM. This study was triggered by an incident which occurred in late March and was extended to include the retubing operation of two VCM reactors in April and July of this year.

On March 26, 1963, a VCM reactor (22R1-4) was shut down at 0400 to replace a leaking top head gasket. Nitrogen was used to purge out the organics while steam was kept on the shell side to keep the reactor hot. Later the steam was stopped, and the reactor cooled down to 44°C., preparatory to performance of the required work on daylight hours (March 28). However, it was felt there was still too much HCl and organics on the bed, so purging and steaming were resumed. At 0400, March 28, the steam was again shut off, and the work was performed on the morning of March 29. The temperature of the reactor shell was estimated to be about 72°C. at the time the work was done. The top head was removed, the old gasket removed, a new gasket placed, and the head returned and bolted on. This was done by four boilermakers, requiring about 45 - 60 minutes during which time these men were exposed. No ventilation other than natural air currents was provided.

Also on March 28, the same four boilermakers were involved in the removal of portions of the catalyst screen on 22R1-5. Two of these men, Lucas and Hawkins, performed the burning work of removing the screen sections. They were occupied in this job almost continuously during the four afternoon hours. The other two boilermakers worked only off and on in the vicinity of this particular job. The cutting of the screen involves the use of a torch to cut the screen directly below the bottom tube sheet. A section of tubes adjacent to the point of cutting had been emptied of catalyst. It is impossible to cut the screen without transferring some heat to the tube sheet and reactor tubes full of catalyst nearby.

It could not be determined which incident or if both incidents constituted the exposure of these employees.

CBY 1017893

RSV0031920

Late Friday afternoon, Lucas noticed that he had a measles-like rash on his lower legs. By Monday morning, April 1, when he reported to the dispensary, he was badly welled around his neck, arm pits, waist, lower body and legs. He was referred to our doctor who, upon learning of the suspected exposure, obtained a urine specimen from the patient and treated his skin eruptions. By Tuesday morning, he reported directly to the doctor because by now he had considerable swelling around the eyes and in the legs. The swelling, upon treatment, quickly subsided and he returned to work.

On Thursday, April 4, the specimen result was reported at 214 micrograms of mercury per liter of sample (normal is 80). An investigation was immediately begun, and the following steps were agreed to be taken:

1. Safety department will find if a mercuric chloride detector is available (ordered on April 7 and received on May 3). Each handling of the catalyst bed will be tested during the work. This will continue until the safety department is knowledgeable of the extent of the hazard and is satisfied with the control of that hazard.
2. Operations will immediately revise the written operating instructions to require that the reactor be cooled to ambient temperature before maintenance personnel will be permitted to work on the reactor.
3. Maintenance will immediately remove the boilermaker with the rash from the area. In addition, the other three boilermakers will be informed of the situation and specimens taken.
4. Depending on the results of the various tests, a rotation plan for maintenance workers in this particular area will be considered.

On Tuesday, April 9, the results of the other three boilermakers were obtained and found to be in excess of normal. Each man was informed individually by the Safety Director. Also, two other men were then sampled--one was the VCM porter (Williams) who for many years has handled catalyst and probably has been exposed to the dust more than any one other individual (he was found to be normal); the other man (Mapes) was a boilermaker who had worked every catalyst-handling job in the reactor section for the past year and a half and has worked in the area five of the last seven years but did not work the specific jobs described herein (he was found to be normal).

It is interesting to note that of the four boilermakers, Hawkins, who exhibited the highest level, was new to the reactor area having been assigned to that area on March 27, only one day before the incidents described.

CBY 1017894

RSV0031921

On the basis of the results, Lucas (on April 1, 1963) and Jensen and Hawkins (on April 8, 1963) were removed from this area. Uptmor was left in the area. Samples were taken approximately one week, one month and two months later and the results, although not conclusive, would indicate that all were normal and the exposure was minimal. The results of these tests are shown in Table I. The doubt arises from the erratic results obtained. The Complete Clinical Laboratories of Dallas, who performed the analytical work, suggested the use of new containers for each sample, and this was done after June 15.

Discussions of the medical evaluation of the problem and individuals with Dr. Matlage and Mr. Garrett would lead to the conclusion that all four men had experienced only a minimal exposure, that the removal of the men from the area was unnecessary, and that there would be no permanent effects as a result of this exposure. The real gain afforded by this incident was the re-evaluation of the potential hazard and the review and revision of work procedures.

Certain environmental tests were made by safety department personnel using a Kitagawa Gas Detector. No mercury vapor was found during the loading of 22R1-3 on May 9, 1963, or on the unheaded but catalyst full 22R1-5 on May 10, 1963. When 22R1-5 was empty and the tubes were being drilled out of the top tube sheet in preparation for the cutting of the tubes on June 18, tests indicated a maximum allowable concentration of mercury directly on the tube sheet but no mercury at five feet above the tube sheet. Results are compiled in Table II.

In April 1963, a VCM reactor, 22R1-6, was retubed. The old tubes were removed by cutting "windows" in the reactor shell, placing a man inside the shell to cut by torch a three-foot section of each tube so that the bottom tube sheet could be dropped, and then drill out from the top the remaining section of each tube. This work was performed by several crews on a continuous basis from April 11 thru April 19. The men were ventilated with fans sucking air away from the work, and the cutter was equipped with an air-ventilated welder's helmet. Two of the boilermakers, Moore and Guss, knowing of the other exposure, requested that they be tested for mercury. This was done on April 17, and the results indicated a minimal exposure (146 and 147 mcg/liter respectively).

After this job was completed, the work method was discussed with the two men. One method for an exposure to occur was recognized from the discussion. The man while performing the cutting of the tubes had the ventilated helmet in place but would flip up the mask to see what he had cut. This left him exposed inside the reactor shell without the benefit of the mask air circulation.

In July 1963, another reactor, 22R1-5, was retubed. The two boilermakers requested that they be assigned to this job and checked for

CBY 1017895

RSV0031922

mercury exposure. This was done, and in addition two other boiler-makers, Jolly and Land, were also checked. All members of the crew were instructed on keeping the ventilated helmet in place during their work inside the shell. The results of their specimen mercury checks are attached in Table III. The elevation was slight but not above the normal maximum of 80 mcg/l., and no health hazard due to mercury exposure was sustained by the men.

To provide reference to understand the results of the urine mercury checks, 0 - 80 micrograms per liter is considered normal; above 80 mcg/l. would indicate an exposure. An instantaneous exposure resulting in a concentration of more than 80 but less than 300 mcg/l. would be considered a minimal exposure requiring the removal of the individual from the area if the exposure was still present; above 300 mcg/l. would be considered a definite exposure requiring the removal of the individual from any contact with mercury for three months or until mercury content drops below 80 mcg/l. Prolonged exposures causing the level to remain above 300 mcg/l. for a long period of time could result in serious health problems and disability. Such occurrences are extremely rare in American industry.

During the second reactor (22R1-5) retubing operation, environmental mercury checks were made by safety department personnel using a Drager Gas Detector. This instrument is capable of measurements in excess of the MAC of 0.1 mcg/m³, the maximum of the Kitagawa Gas Detector.

In preparation for the removal of the reactor tubes, the reactor was unheated, emptied of catalyst, and the tubes washed and rattled. There were 15" x 20" windows cut in the reactor shell on the north-east and southwest corners and a 4800 cfm. 6" venturi blower was installed to suck out air through the southwest window. Data is compiled in Table IV. The highest concentration was experienced while using the Cutrode (3/16" rod) and more smoke was visible, both inside and issuing out the bottom and top of the reactor, when this cutting rod was used.

It is the opinion of the safety department that the hazard of mercury poisoning in the VCM reactor area is minimal but varied depending on the operation involved.

1. Normal personal hygiene would eliminate any hazard from mercury absorption through the skin.
2. Washing the hands and face before eating or smoking is desirable to avoid catalyst ingestion by mouth.
3. The greatest exposure is by oral inhalation of mercury vapors, and these can be avoided entirely or reduced to a non-hazardous level by adequate fresh air ventilation of the worker and the elimination of the exposure to

CBY 1017896

RSV0031923

catalyst above ambient temperature. Although no maximum safe bed temperature can be specified, the atmosphere above a 100°F. bed is considered non-hazardous and work can be performed safely at bed temperatures in excess of this if adequate personal ventilation is provided.

4. It is recommended that during heating or cutting operations involving an open reactor, whether filled with catalyst or not, only necessary work be done in the vicinity of the reactor and the area above and beneath the reactor being worked on be roped off.
5. When reactor retubing is to be performed, "rattling" of the emptied and washed tubes reduces the exposure significantly and makes the job cleaner and easier.

gil

C. L. Gilmore

/ds

Attachments - 3

CBY 1017897

RSV0031924