The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Rescue Effort Results in Fatality for a Wire Manufacturing Plant Worker in Illinois

FACE-8527

Introduction:

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related and confined space-related fatalities. By scientifically collecting data from a sample of fatal accidents, it will be possible to identify and rank factors that increase the risk of fatal injuries for selected employees.

On June 7, 1985, a 43-year-old production foreman of a wire processing company was summoned to aid a maintenance crewman (his son), who had collapsed at the bottom of an open top clarifying tank. The 18 year-old summer employee had been overcome by fumes liberated from chemical sludge that he was removing from inside the tank. In a rescue attempt the production foreman collapsed upon entering the tank. He was later removed from the tank. by the fire/rescue team and pronounced dead. The fire/rescue team also removed the crewman. He was admitted to the intensive care unit of a local hospital and later released.

Contacts/Activities:

The Division of Safety Research was contacted by the NIOSH Region V consultant. DSR personnel contacted the cognizant OSHA compliance officer and the company and decided that a FACE investigation would be conducted. A research team consisting of an industrial hygienist and a safety specialist met with the OSHA compliance officer and discussed the information available at that time. The team then met with an employer representative who advised the team that incident-specific information would not be provided in accordance with recent corporate attorney directives. The report which follows is based upon information obtained from the OSHA compliance officer.

The company employing the victim has been in operation for over 30 years as a wire processing operation. The facility employs a total of 100 persons in various manufacturing and maintenance capacities.

Synopsis of Events:

The victim was a production foreman employed by the company for 20 years. He was alleged to have undergone major heart surgery within the past five years and was apparently taking medication for a related condition.

On June 5, 1985, three employees (two summer hires and a lead man) began cleaning an above-ground, open top clarifier tank (6' wide, 6' long, 10' deep). The steel structure is an integral part of the company's wastewater treatment system that is used primarily for handling spent acids from pickling tanks (used to descale steel-alloy wire). After the spent acid solutions (which contain metal scale from the wire) have been neutralized in a neutralization tank and processed through a bag entrainment system, the clarifier tank serves as a settling tank for sludge fines. The tank has a small drain at the bottom that is used to pump sludge out of the tank on a weekly basis. However, as there are not scrappers or other means of agitation in the tank, the sludge builds up in the bottom of the tank. As a result the tank's capacity decreases through use. It has been necessary to clean the tank once a year for the past several years. The tank was approximately three quarters full when the cleaning operation began (pumping out the sludge from the tank via a portable pump with a hose inserted into the sludge at the top of the tank). Discharge was into 55 gallon containers. One crew member held the end of the pump hose into the sludge from a 2 by 12 inch plank that had been laid diagonally across the top of the tank. This is the same cleaning procedure that had been followed in previous years. Previous cleanings stopped before the tank was fully emptied of sludge, because the tank was needed for production. This year a decision was made to remove all the sludge from the tank.

Pumping operations resumed on June 6th and continued until the sludge became too thick to pump. At this point approximately three feet of sludge remained in the tank. When the sludge got down to a level where it couldn't be reached from the 2 by 12 plank on top, a crew member entered the tank via wooden ladders that had been propped against the outside and inside of the tank. From the ladder the crew member held the hose from the pump into the sludge. A second crew member, who stood on the 2 by 12 plank, stirred the sludge with a 2 by 4. The stirring action was intended to keep the fines suspended in the fluid. When the pump could no longer be used, a manual removal system was devised. This involved scooping sludge with a shovel into buckets and hoisting the buckets on a rope with a block and tackle that was affixed to the ceiling. The rope was operated by a crew member on the ground on the exterior of the tank. After four buckets were filled and hoisted, the two crewmen exchanged jobs. The lead man supervised this operation and made sure the workmen were supplied with 55 gallon drums in which to dump the sludge. Additional lights were installed on the ceiling above the tank to provide illumination inside. A box window fan was used to provide ventilation inside the tank. It was positioned either to blow air in or out depending on how the crew member in the tank felt most comfortable. Crew members entering the tank were required to wear chemical resistant suits, boots, gloves, safety glasses, and face shields. Respirators were optional. Upon entering the tank, both crewmen apparently informed the lead man that the odor inside was making them feel "high"; however, scooping operations continued for the rest of the day.

On June 7, 1985, the crew started working at 8:30 a.m. At this time approximately 1 1/2 feet of sludge remained in the tank. The crewmen again told the lead man that the odor in the tank was making them "high" and that it was much more intense than the day before; however, scooping operations continued. Two buckets (instead of four) were filled before switching jobs. One crewman volunteered to go into the tank more often because the odor was affecting the other crewman more. The lead man left the plant at approximately 10:40 a.m. on personal business. Before he left, he had a discussion with the maintenance superintendent (who was in charge of this cleaning operation) concerning the cleaning of the tank. A decision was made at that time to allow the work to continue. At approximately 11:00 a.m. the crewman on the outside of the tank heard a thud from inside. He climbed the ladder and observed the other crewman staggering around inside the tank and then collapse into the sludge. The second crewman entered the tank and attempted to revive the first. Failing, he climbed out of the tank and ran into the yard of the plant. He explained the situation to a forklift driver, who ran to the clarifier tank, climbed the ladder, and went inside in an attempt to rescue the first crewman. The second crewman continued through the plant and alerted the production foreman (father of the collapsed crewman). The production foreman ran to the clarifier tank, climbed the ladder, and jumped inside. Some shouting was heard inside the tank as various other plant personnel arrived. The forklift driver then came to the top of the tank and had to be helped out by a maintenance man. The maintenance superintendent arrived and began directing operations. He ordered several people to go get additional fans, ropes for hoisting, and respirators or oxygen masks. Then he and another maintenance man twice attempted to rescue the people in the tank. Both times they had to abandon their efforts due to the intense atmosphere in the tank. At this point the maintenance superintendent would permit no one else to enter the tank. Portable fans and a high speed blower were directed into the tank in an attempt to ventilate the area while waiting for the rescue squad to arrive.

Minutes later, the rescue squad arrived. Members of the rescue squad donned chemical protective suits and self-contained breathing apparatus (SCBA) and entered the tank. The crewman was removed first. As the rescuers and the crewman reached the top of the ladder, the crewman began to aid himself in getting out of the tank. He was brought down, his

clothing removed, and oxygen administered. Two other rescuers suited up and went into the tank. The production foreman was unconscious and he had to be lifted out of the tank via a rope. He was administered CPR. However, he was pronounced dead on arrival at the local hospital. The crewman was admitted to the intensive care unit of the hospital, but later released.

Recommendations/Discussion:

Recommendation #1: The method of descaling and the method of cleaning out the clarifier tank should be evaluated, to determine if either could be changed to minimize/eliminate the exposure to the acids or the need to enter the confined space.

Discussion: The descaling process should be evaluated and less hazardous chemicals substituted, where possible. To clean the sludge build-up inside the clarifier tank, entry was necessary. If removal methods were mechanically incorporated inside the tank, sludge build-up would not occur and manual cleaning of the tank would not be necessary.

Sludge was pumped out of the tank until it became too thick to pump. Other methods should have been investigated for the removal of sludge from the tank before resorting to manual methods. One possible solution, which has worked in the past, is to fill the tank part way with water and then place an air hose in the tank. Air agitation would then help to liquefy the sludge to a point where it could once again be pumped out. Prior to using this method of removal, the sludge should be evaluated to assure that it is not reactive with water. A basic pH indication within the range of 5.5 to 8.5 will provide this assurance.

Recommendation #2: Employers should develop comprehensive policies and procedures for confined space entry and emergency exit.

Discussion: Prior to confined space entry, all hazardous operations should be explained by written procedures that address all types of emergencies. These procedures should minimally include the following:

1. Air quality testing; 2. Identification of chemicals, possible chemical reactions, and chemical exposures; 3. Hazard communication of potentially hazardous chemicals and chemical reactions; 4. Personal and supervisory training in usage of respiratory protection; 5. Development of site specific work plans and procedures that address the task being performed, emergency access, and egress; 6. Training for proper selection of personal protective clothing, based on exposures; 7. Emergency rescue training; 8. Availability, storage, and maintenance of emergency rescue equipment; 9. Availability and usage of life lines, harnesses, and man lifts.

Job safety analysis procedures should be developed for all operations. Workers who enter confined spaces should complete training designed to inform them of the hazards they may encounter.

From the information obtained by the OSHA compliance officer, the employer in this case did not address any of the above items prior to the accident. Employer rescue efforts were not the result of preplanning or forethought.

Recommendation #3: Firefighters, paramedics, and others responsible for emergency rescue should be trained for confined space rescue.

Discussion: The volunteer fire/rescue team made several unsuccessful attempts to remove the victim from the confined space. Adequate exit means (such as life lines, harnesses, or man lifts) were not available. Emergency rescue teams should be cognizant of all hazards of the confined space, including rescue hindrances, and should wear proper personal protective equipment and devices for emergency egress.

Recommendation #4: Hazardous exposure monitoring and control should be established.

Discussion: The employer appeared to have no written program to identify and evaluate existing hazardous conditions. Additionally, the facility did not have a, ventilation system. During the tank cleaning process, portable household fans were being used to provide air circulation. Ventilation rates should meet industrial hygiene standards for areas where there is an

exposure to potentially hazardous chemicals. Ventilation should be maintained close to maximum efficiency. Adequacy of a system can only be determined through environmental monitoring.

Recommendation #5: All chemicals in use and those being stored should be clearly identified and compliance with exposure limits should be enforced.

Discussion: Supervisory personnel apparently did not identify the chemicals present in the confined space and the crewmen were unfamiliar with the chemicals to which they were being exposed. One crewman had recognized some adverse effects of those chemicals and removed himself from the exposure; however, corrective action was not initiated by supervisory personnel or the other crewman. Poor hazard awareness was displayed by both supervisory personnel, who did not question the air quality in the presence of an unknown chemical exposure, and by the overcome crewman.

Chemicals known to be used for pickling (descaling of steel-alloy wire) are nitric, phosphoric, sulfuric, hydrochloric acid, and combinations of these acids. Water in contact with these acids and mixed acids will cause considerable evolution of heat and may evolve toxic fumes.

Chemicals used for neutralization of spent acids are lime, phosphate, and copper sulfate.

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