The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Worker Dies Inside Filtration Tank in Michigan

FACE 8747

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. The purpose of the FACE program is to identify and rank factors that influence the risk of fatal injuries for selected employees.

On May 12, 1987, a city worker died while checking the inside of an empty filtration tank at a sewage treatment plant.

CONTACTS/ACTIVITIES

The Water Pollution Control Federation (WPCF) notified the Division of Safety Research (DSR) of this fatality and requested technical assistance. This case has been included in the FACE Project. On June 15-16, 1987, a DSR research industrial hygienist conducted a site visit, collected incident data, photographed the site, and interviewed representatives of the employer and comparison workers.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident is a municipality with a resident population of approximately 160,000. The victim worked at the wastewater treatment plant (in the wastewater treatment department) which has a total of 56 employees, primarily plant operators and plant maintenance personnel. Additionally, there are five lab technicians, three plant foremen, a chemist, a civil engineer, office personnel, and a plant supervisor.

New employees are given a half-day orientation concerning the operating policy of the city. Time off is provided for mandatory reading of safety booklets. All employees are given formal training in hazardous communication, material safety data sheets/"right to know", and the use of self-contained breathing apparatus. Continual on-the-job task training also addresses various hazards encountered on a day-to-day basis. Workplace safety is stressed as a responsibility of each employee. A wastewater treatment plant safety committee which consists of the plant superintendent, two union stewards (a plant maintenance worker and a plant operator), a maintenance foreman, and the civil engineer meets monthly. Accident reports, safety equipment, safety complaints from employees, the implementation of safety directives from management, etc. are discussed at these committee meetings. The two union stewards are given additional time to evaluate employee complaints and safety concerns in the plant. No training is given on confined space entry; however, plant supervisors have necessary testing equipment available to test a confined space atmosphere for oxygen (O_2), hydrogen sulfide (H_2S), and explosive gases. The plant also has several self contained breathing apparatus (SCBA) throughout the plant facility.

SYNOPSIS OF EVENTS

A 55 year-old wastewater treatment plant operator (the victim) with 25 years of experience was inspecting one of twelve open-top concrete filter tanks (used for tertiary wastewater treatment) when this incident occurred. Each filter tank is 15 feet wide x 24 feet long x 12 feet deep and is divided vertically in the middle by a concrete baffle. The bottom of each tank contains a filter bed (several feet of filter media composed of graduated sized stone, covered by approximately 12 inches of wheat-sized anthracite coal). Four trough-like weirs spaced equally apart span the width of each tank half, three feet above the top of the filter media. A concrete walkway with steel safety rails is located around the top of each tank. Each tank operates with approximately nine feet of wastewater and is backwashed three times per day. During this process, a small amount of the filter media (i.e. coal) is washed away. In order to determine the amount of filter media lost, the victim (or other plant operators, when assigned) periodically drain each tank and measure the depth of the filter media. To do this employees are required to lower an aluminum ladder into the tank, positioning the feet of the ladder inside a weir, climb into the tank with a steel tape, measure the depth of the filter media, climb back out, and place the filter tank back in operation. This process is repeated for all the filter tanks. The victim had been assigned to inspect the depth of the filter media in all of the filter tanks (a task which he had done at least twice before). Four days prior to the day of the accident the victim had inspected six tanks. The acting plant foreman (the victim's supervisor) was not aware of the victim having experienced any ill effects from these tank inspections.

On May 12, 1987, the victim reported to work at 8:00 a.m. and was asked by the plant foreman if he required any assistance in the completion of the remaining six tank inspections. The victim said "no" and completed the inspection of one tank and, although there were no eye witnesses, it is presumed that he was in the process of climbing either into or out of a second tank when he fell from the ladder into the weir. The victim struck his head on a ladder rung or on an edge of the weir.

At approximately 10:55 a.m. the victim's supervisor noticed that the filter tank being inspected had no filter tank valve changes documented on the computer for several minutes. The supervisor left the control room and entered the tertiary filter tank building to check on the victim. The supervisor found the victim lying unconscious inside a weir at the bottom of the tank. The supervisor immediately notified office personnel in the plant, who notified the city fire department emergency rescue squad and then summoned a maintenance worker for help. The supervisor and the maintenance worker entered the filter tank, but did not attempt cardiopulmonary resuscitation (CPR). The rescue squad arrived on the scene approximately two and a half minutes after being called, entered the tank, hoisted the victim out, and began to administer CPR. Resuscitation efforts were unsuccessful. The county medical examiner arrived on the scene at about 1:00 p.m. and pronounced the victim dead at the scene.

CAUSE OF DEATH

An autopsy was conducted and the cause of death listed by the medical examiner was hypertensive and arteriosclerotic heart disease. Also, according to the medical examiner: "Advanced emphysema of the lungs may have contributed to the death. The deceased was considerably overweight . . .", the ". . . laceration of the left side of the head was sustained as a result of the terminal fall.", and "Yellow discoloration of the skull may have been related to diabetes mellitus."

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Workers who are required to enter confined spaces to perform tasks as part of their job responsibilities should receive pre-placement and periodic physical examinations to determine that they are physically capable of performing these duties.

Discussion: Simply entering and exiting the filter bed placed a great deal of stress on the victim's cardiopulmonary system. Because of pre-existing medical problems (emphysema, arteriosclerotic heart disease, obesity, and diabetes), which were apparently unknown to the victim, he was unable to withstand this stress. This fatality underscores the advisability of pre-placement and periodic physical examinations for any strenuous work, especially in a confined space.

Recommendation #2: The employer should develop a written comprehensive safety program that clearly documents procedures for safe entry into confined spaces.

Discussion: All employees who work in or around confined spaces (wastewater treatment plant employees) should be aware of potential hazards, possible emergencies, and specific procedures to be followed prior to entering a confined space. These procedures should include, but not be limited to:

1. Air quality testing to determine adequate 0_2 level.
2. Ventilation of the space to remove air contaminants.
3. Monitoring of the space to determine a safe oxygen level is maintained.
4. Employee training in confined space entry, testing, and use of personal protective equipment (respirators, clothing, etc.).
5. Standby person outside the confined space for communication and visual monitoring.
6. Emergency rescue procedures.

Even though there were no dangerous air contaminants in the confined space and normal oxygen levels were found in air samples taken inside the filter tank by the DSR research industrial hygienist at the time of the on-site evaluation, entry into confined spaces should not be attempted until atmospheric testing of the confined space insures that the atmosphere is safe. This testing requirement applies to all confined spaces, including the inside of open-top tertiary filter tanks. Testing must be done by a qualified person prior to entry. Specific recommendations regarding safe work practices in confined spaces can be found in the NIOSH Publication No. 80-106, “Working in Confined Spaces”. This publication also defines and provides recommendations on hot work, isolation, purging, ventilation, communication, entry and rescue, training, posting, safety equipment, clothing, etc.

Recommendation #3: A trained standby person should remain outside of the confined space when a worker enters or works inside. The standby person should visually monitor the tasks being performed inside and should be able to communicate with the worker(s) inside the confined space.

Discussion: A person trained in emergency rescue procedures, assigned to remain on the outside of the confined space for communication and visual monitoring of the person inside is of utmost importance.

Recommendation #4: Employees should be trained in cardiopulmonary resuscitation (CPR).

Discussion: CPR should begin as soon as possible, minimally within 4 minutes (in accordance with American Heart Association guidelines) in order to achieve the best results. To meet this criteria for successful resuscitation, workers should be trained in CPR to support the victim’s circulation and ventilation until trained medical personnel arrive. While some employees had apparently received CPR training in the past, employees who arrived at the scene of the accident (prior to the arrival of emergency medical personnel) did not begin CPR on the victim. Retraining in CPR is necessary, usually on an annual basis.

Recommendation #5: The procedure used to measure the level of filter media present in a tank should be evaluated to determine if the procedure could be modified to eliminate the need to enter the confined space.

Discussion: Prior to entry into a confined space one of the first questions that needs to be addressed is whether entry is necessary. The procedure used to measure the level of filter media present in a tank should be evaluated to determine if it could be modified to eliminate the need for entry into the tank.

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