



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces  
through safety and health research



# Worker Dies While Repairing a Vacuum Evaporator Tank in Virginia

FACE 8725

## 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 November 11, 1986, a department manager (the victim) at a synthetic fiber manufacturing plant was patching the outside of a 10,000 gallon acid vacuum evaporator tank when the accident occurred. The tank imploded, and the negative pressure differential pulled the victim into the tank through a 12" x 54" opening. The victim was removed from the tank by the local fire department rescue squad and pronounced dead at the scene by the medical examiner.

Another confined space-related fatal accident occurred within the same plant approximately one month subsequent to this accident. A separate evaluation of that accident is given in FACE report 87-26-II.

## Contacts/Activities:

Officials of the Occupational Safety and Health Program for the Commonwealth of Virginia notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) concerning this fatality and requested technical assistance. This case has been included in the FACE Project. On February 9, 1987, a DSR research team (two research industrial hygienists and a safety engineer) met with the compliance officer conducting the investigation for the Commonwealth, a company representative, and the company safety officer. Comparison workers and a surrogate for the victim were interviewed and photographs were taken of the accident site.

## Overview of Employer's Safety Program:

The employer in this incident is a synthetic fiber manufacturing plant that has approximately 1,200 employees consisting mainly of maintenance and production workers, pipefitters, mechanics, and machinists.

The company has a plant safety program. New employees receive a basic plant safety orientation from the safety training supervisor and a handbook which discusses general employee safety. All production employees receive fork lift truck safety training. New employees also receive on-the-job training for specialized procedures required in certain manufacturing

processes. There is a written hazard communication (i.e. right-to-know) program that addresses various department-specific hazards throughout the plant and a written policy on confined space entry procedures. All employees working in or near confined spaces are expected to be familiar with the confined space entry procedures; however, there does not appear to be an effective means to make employees aware of the potential hazards associated with these tasks.

Safety meetings are conducted monthly among company management to discuss problems and to reinforce existing safety programs; however, safety meetings are not conducted regularly within the various plant departments.

## Synopsis of Events:

The 10,000 gallon acid vacuum evaporator tank involved in the accident was originally manufactured in 1971 with 0.625 inch thick steel and a rubber liner designed to prevent the evaporator tank contents (approximately 10% sulfuric acid solution) from coming in contact with the steel. Several months prior to the accident, the rubber liner in the evaporator tank had been damaged during repair and was no longer intact. As a result, the steel wall of the tank had been reduced to a thickness of only 0.13 to 0.21 inches at the time of the accident.

On November 11, 1986, during the day shift, the evaporator tank was taken off line and “boiled out” with caustic soda; a standard operating procedure to remove accumulated scale deposits. At approximately 7:30 p.m. the evaporator tank was placed back on line; however, the evaporator system would not start up and would break vacuum whenever steam was applied. A worker patched several small holes (approximately 1/8 to 1/4 inch in diameter) on the evaporator tank by putting a sealant putty on the outside of the tank wall. (This patching procedure was used on two separate occasions during the past two months after “boiling out” the tank.) The worker returned to the operator’s station and was able to get the evaporator system started and operating with 25 inches of vacuum.

The department manager (the victim), after observing the vacuum level, remarked that there must be another small hole somewhere in the evaporator tank and that he was going to check on it. Although there were no eye witnesses, it is presumed that the victim was patching the outside of the evaporator tank when it suddenly imploded. The force of the implosion pulled the victim into the tank through a hole (approximately 12 inches x 54 inches) created from the implosion. The implosion also pulled the wall of the evaporator tank inward about 18 inches in the area immediately around the hole created by the implosion.

Two workers heard “a big explosion” at about 9:45 p.m. , but felt that it was “... a churn from the viscous side of the plant”. Other employees thought it was a normal “plant noise”. At 10:00 p.m. the worker went to the evaporator tank operator’s station and saw that there was no vacuum reading on the gauge of the evaporator tank. The worker looked up at the evaporator tank and noticed a big hole in its side. Since the victim could not be located, an all-out search was initiated. About 45 minutes later the foreman looked inside the evaporator tank through the hole created by the implosion and found the victim lying at the bottom in about 12 to 18 inches of acid. The fire department rescue squad was immediately notified and arrived at the scene approximately six minutes later. Rescuers donned self-contained breathing apparatus and removed the victim through a manhole in the evaporator tank. The victim was pronounced dead at the scene by the local medical examiner.

## Cause of Death:

The medical examiner’s autopsy report lists the cause of death as multiple severe injuries (chemical burns and skull fractures).

## Recommendations/Discussion:

**Recommendation #1:** The employer should implement an inspection and maintenance program for all vacuum vessels.

Discussion: Although the employer has a maintenance and inspection program (required by state law) for all its pressure vessels, a maintenance and inspection program for all vacuum vessels should also be implemented. The object of the program should be two fold: 1) to identify faulty vacuum vessels which may result from corrosion, physical damage, deteriorated rubber liners, etc., and 2) to assure that all maintenance and repair of those vessels are completed in accordance with the manufacturer's specifications.

**Recommendation #2: The employer should conduct regular safety meetings in each department.**

Discussion: Departmental safety meetings should address specific job-related safety problems and hazards, and employees should be encouraged to identify potential hazards encountered on the job. This information should then be forwarded to the safety officer and company management, where appropriate action can be taken to reduce or eliminate such hazards.

**Recommendation #3: The employer should insure that employees are trained in hazard recognition and safety awareness for all potentially hazardous tasks.**

Discussion: Although the employer has a written hazard communication program and safety policy (including confined space entry procedures), there appears to be no effective means of communicating hazard recognition and safety awareness to employees. When confronted with potential on-the-job hazards, employees should be able to recognize these hazards and take appropriate corrective actions.

**Recommendation #4: The employer should implement and enforce its safety program.**

Discussion: Although the employer has a written safety policy (including written confined space entry procedures) it appears that these policies and procedures were not being followed by supervisory personnel. Management should ensure that its safety policies and procedures are put into practice by all department supervisory personnel, as well as plant laborers. Enforcement procedures should be implemented to improve employee compliance with the safety program.

**Recommendation #5: The employer should implement an improved housekeeping program.**

Discussion: Section 5.5 of the employers safety policy states, "Housekeeping is often a barometer of attitudes concerning safety, quality and cost." Maintaining work areas in a clean and orderly condition will improve worker safety. Procedural references to housekeeping in the safety policy should be strictly followed.

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