ADMINISTRATIVE REPORT **DATE: September 4, 1996**
PUBLIC HEALTH SERVICE/CDC/NIOSH/DSR
FACE-96-22

TO: **Director, National Institute for Occupational Safety and Health**

FROM: **Division of Safety Research, NIOSH**

SUBJECT: **Two Truck Drivers Die After Cement Tank Collapses--Virginia**

SUMMARY

A 31-year-old truck driver (victim 1) and a 29-year-old truck driver (victim 2) were killed, and a 31-year-old plant manager was injured during the collapse of a cement-filled tank at a concrete plant. The tank, which was scheduled to be taken down for renovation the following day, contained just over 50 tons of powdered cement when it collapsed. The three workers had been working on a conveyor belt which transported crushed stone to the weigh hopper mounted on the tank support structure, and were in the process of adjusting the conveyor's drive belt when, without warning, the tank collapsed onto the conveyor, trapping the workers. The plant was undergoing modernization, and company officials who were touring the site witnessed the collapse. They notified a local fire department emergency rescue service which responded within 5 minutes and recovered the victims from the wreckage. The two truck drivers were both dead at the scene.

NIOSH investigators concluded that, in order to prevent similar incidents, employers should:

- *conduct regular structural inspections and evaluations to ensure that plant structures are maintained in good repair to prevent injury.*

INTRODUCTION

On March 14, 1996, a 31-year-old truck driver and a 29-year-old truck driver were killed during the collapse of a cement tank at a concrete plant. On April 22, 1996, the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On May 15, 1996, a DSR safety engineer reviewed the incident with the VAOSHA compliance officer, traveled to the incident site, and interviewed the company president and safety director. The incident site was examined and photographs were taken.

The employer, a ready-mix concrete supplier, had conducted business at the site since 1974. A total of 79 employees operated the company's four ready-mix concrete plants, one of which was the incident site, the company also operated a concrete-recycling plant, and a sand and gravel facility. The company employed a full time safety director and had been working for the past 1½ years to upgrade the company safety program and modernize facilities. The company had a written safety policy and written safety program which included confined-space-safety procedures, lockout/tagout procedures and driver safety. Regular monthly production and safety meetings were conducted. Work tasks were learned on the job under the observation of an experienced worker. The ready-mix plant was computer controlled and was operated by a plant manager from a control room. These were the company's first fatalities.

INVESTIGATION

The ready-mix facility where the incident occurred included an aggregate bin, two tanks (#1 and #2) containing cement and flyash, and a conveyor system (Figure). Tank #1 had been on-site when the company purchased the facility in 1974. At that time it had been used to store cement. The tank was equipped with a weigh hopper which weighed both the material discharged from the tank, and that which was discharged from the aggregate conveyor. The hopper was controlled by the plant operator from the control room. Over the years the facility had been upgraded by the addition of other equipment. Specifically tank #2 had been erected beside tank #1. Tank #2 was then used for storage of cement and tank #1 was used for flyash storage. The weigh hopper remained mounted under tank #1 and material from tank #2 was transported to the weigh hopper by a pneumatic conveyor system. Because tank #2 did not have a ladder, a catwalk had been installed between tank #1 and tank #2. During the last few years, the size of jobs the company was called on to supply increased, and the facility was undergoing modernization to accommodate larger batches of concrete. As part of the modernization, both tanks were scheduled to be taken down, refurbished and then re-erected. All connections between tank #1 and tank #2 had been cut approximately 24 hours before the incident and tank #2 had been emptied and taken down. In order to continue production, the 330-barrel tank #1, under which the weigh hopper was mounted, had been filled with cement, and contained about 50 tons of material. On the day of the incident, the plant manager had begun loading trucks at 7:24 a.m., and had loaded out 18 loads by 11 a.m., when the coordinator system which transported the aggregate to the weigh hopper under tank #1 began to malfunction. According to the safety coordinator, this was not uncommon. The plant manager began a trouble-shooting procedure starting at the aggregate

hopper. He checked various control systems up to the conveyor. When he checked the conveyor, he discovered the drive belt from the motor to the head roller was slipping. He decided to adjust the tension on the belt. However, he needed a hammer to loosen the adjusting mechanism. He had been accompanied by two truck drivers (victims #1 and #2) who had decided to help out while waiting for their trucks to be loaded. Victim #1 was with the plant manager at the belt head while victim #2 had gone to get a hammer, and was ascending the locked-out and tagged belt. Victim #2 had ascended about one third of the way up the belt when tank #1 started to topple toward the belt. Tank #1 collapsed on top of the belt, trapping the three workers. Company officials who were touring the plant to assess the progress of modernization, witnessed the occurrence and immediately notified a local fire department emergency rescue service which responded within 5 minutes. The victims were recovered by the rescue squad, and victims #1 and #2 were dead on the scene. The plant manager was transported to a local hospital, having sustained fractured ribs and a collapsed lung.

Investigation later revealed severe corrosion damage to the legs supporting the tank. While it could not be determined which structural member of the tank's supporting frame may have initiated the collapse, the corroded legs would have been weakened in their ability to support the tank. Further, although the tank was reported to have collapsed without warning, evaluation suggests that the tank was already starting to lean around 11 a.m. This is evidenced by the slipping drive belt between the conveyor head roller and the motor. Since the motor was mounted on the tank structure, rather than the conveyor frame, as the tank leaned toward the conveyor, tension was lost in the drive belt.

CAUSE OF DEATH

The medical examiner's report indicated that victim #1 died of multiple internal injuries and victim #2 died of massive head injuries.

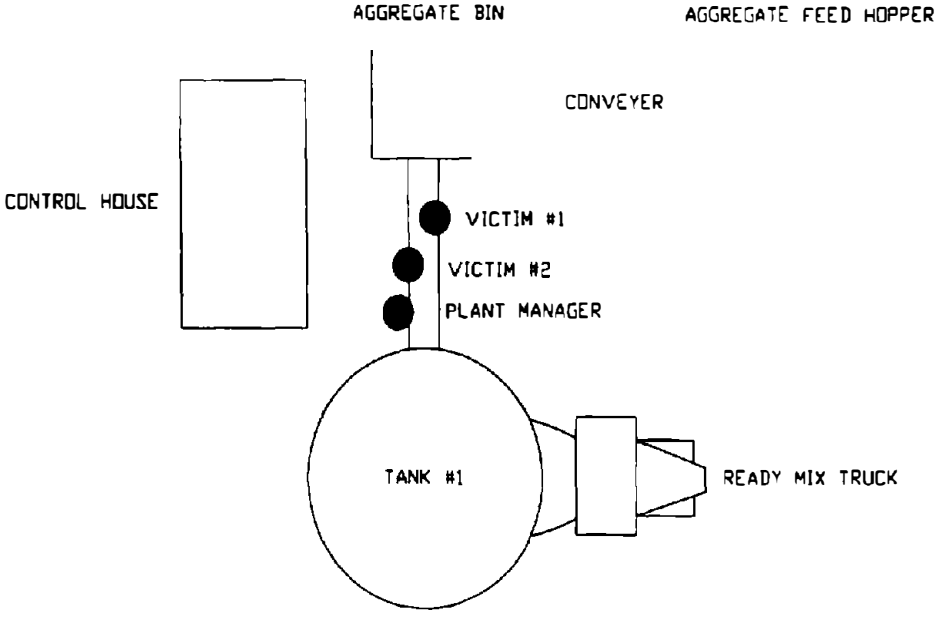
RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: Employers should conduct regular structural inspections and evaluations to ensure that plant structures are maintained in good repair to prevent injury.

Discussion: The tank involved in this incident had been on-site when the company purchased the facility in 1974. Over the years, the ground level around the tank had risen due to spillage, and the concrete footings for the tank's four legs had become covered with accumulated cement spillage. This spillage had accumulated over the steel feet and as high as 6 inches on

the legs. All four legs, wide flange 6¼ inches by 8 inches columns at 24 pounds per foot, had experienced corrosion damage beginning at the foot and extending upward for 12 to 18 inches. The severity of the corrosion varied from moderate scale on one leg to a 1 to 1½ inch hole in the web of one of the other legs. Since the incident the employer has implemented a system of inspections which include visual examinations conducted daily by the plant manager, weekly by maintenance personnel, and yearly by an independent structural engineer. Results of these inspections are recorded and reviewed by the company president. Inspections of this kind can detect defects due to corrosion and mishaps-such as mobile equipment collisions-and correct them before further damage or injury occurs.

FIGURE: FACE 96-22 CEMENT TANK COLLAPSE



SKETCH NOT TO SCALE

Paul H. Moore
Safety Engineer
Trauma Investigations Section
Surveillance and Field
Investigations Branch
Division of Safety Research

Virgil D. Casini
Project Officer
Trauma Investigations Section
Surveillance and Field
Investigations Branch
Division of Safety Research

Ted A. Pettit, M.S., R.E.H.S.
Chief
Trauma Investigations Section
Surveillance and Field
Division of Safety Research

Nancy A. Stout, Ed.D.
Acting Deputy Director
Division of Safety Research

Fatality Assessment and Control Evaluation (FACE) Project

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (FACE) investigations when a participating State reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

States participating in this study: North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.

Additional information regarding this report is available from:

Division of Safety Research
National Institute for Occupational
Safety and Health (NIOSH)
1095 Willowdale Road
Morgantown, West Virginia 26505-2888
Phone: (304) 285-5916
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