THE UNIVERSITY OF IOWA

COLLEGE OF PUBLIC HEALTH
Department of Occupational and Environmental Health

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

FROM: **Iowa FACE** **Case No. 2004IA058** **Report Date: 23 December 2008**

SUBJECT: **Farmer Asphyxiated when Entangled in Drives of Box-type Manure Spreader**

SUMMARY

A 43-year-old farmer from north central Iowa died in the fall of 2004 when he became entangled in the drive mechanism for a box-type manure spreader's distributor/beater and bottom conveyor.

The victim was operating the tractor and manure spreader on a narrow strip of land near the farmstead on the farm he rented. He stopped the tractor and left the operator's position with the tractor's engine running and the tractor's power takeoff (PTO) engaged.

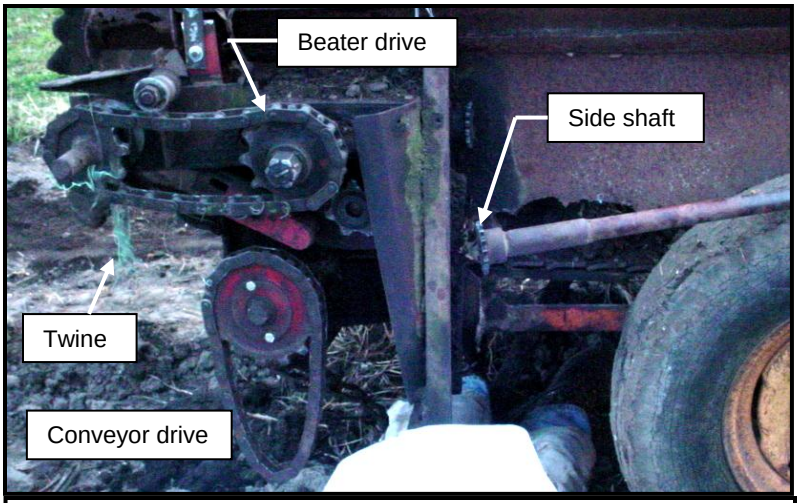

Photo 1 – Victim entangled in chain drives for beater and apron conveyor as well as apron chain of box-type manure spreader.

The tractor's PTO output shaft continued to deliver power to the spreader and onward through its horizontal side shaft to the gearbox for the beater and conveyor drives at the right rear corner of the spreader. The event was unwitnessed, but at some point the victim's clothing was caught and became entangled in the chain drives of the spreader, pulling the victim inward toward the moving mechanism, further entangling him. There was no guarding on the horizontal side shaft or the sprockets and chains at the right rear corner of the spreader where the victim became entangled (Photo 1).

RECOMMENDATIONS

1. *Tractor operators should disengage all PTO-powered mechanisms and stop the tractor's engine before leaving the tractor operator's station, or get assistance from a coworker to inspect moving machinery parts from a safe distance.*

2. *Powered moving machinery parts of agricultural equipment should have the manufacturer's recommended guarding maintained in place to perform its intended function.*

3. *Operators should avoid wearing loose-fitting clothing or clothes that have loose or frayed ends that could be caught in moving machinery parts.*

4. *Machinery should be maintained to minimize breakdowns and interruptions of work tasks.*

INTRODUCTION

A farmer was entangled in the beater and conveyor drive mechanism at the rear corner of a box type manure spreader and died of compressional asphyxiation when his clothing wrapped tightly, drawing him toward the drive mechanism. Iowa FACE personnel were alerted to the incident by a newspaper press clipping. The incident was not witnessed. No onsite investigation was conducted. Information from the Medical Examiner's Office and County Sheriff contributed to this report.

INVESTIGATION

This incident occurred on a rented farm in north central Iowa during the fall of 2004. The farmer, age 43, was wearing boots, jeans, three layers of shirts, and leather gloves. He was last seen by his wife around 3:00 PM when he came to the house after completing some routine chores. They visited about going to town later that day and he said he wanted to spread some manure before they got ready to go and went back outside. She stayed in the house.

The farmer was using a small 26 kW (35 hp) utility tractor made in the early 1960's to pull the manure spreader and provide PTO power to its conveying and distribution mechanisms. The manure spreader had a horizontal power transfer shaft along its right side which ran full length to the gear box at the right rear corner of the manure spreader. Chains and sprockets distributed and transferred power from the gear box to both the beater/distributor and to the apron/conveyor at the bottom of the manure box, which slowly drags manure rearward into the beater's distribution paddles.

The manure spreader showed considerable wear and tear. (Note the hole in the side of the spreader behind the side shaft in Photo 1.) It is inferred that a problem had developed as the farmer operated the tractor and manure spreader combination, and the farmer got off the tractor to investigate, leaving its engine running and its PTO engaged, which allowed the manure spreader's moving machinery parts to continue to operate. Investigation photos showed the beater paddles were not clogged, but there was some plastic baling twine wrapped around the beater's axle near its right end bearing. At the back right corner of the spreader the victim's clothing became entangled in the chain drives for the beater and conveyor as well as in the conveyor.

About 4:15 PM the landlord discovered the farmer, informed the farmer's wife that the farmer had been entangled in the manure spreader, and instructed her to call for emergency medical assistance. The wife immediately called 911 and hurried to the scene. The farmer's clothing was partially torn away and his wife could detect no pulse.

Emergency responders arrived on scene at 4:30 PM and extricated the farmer from the drive mechanism. A secured landing zone for a helicopter was set up in the harvested soybean field nearby. The farmer was pronounced dead at the scene.

Photographs taken at the scene by the County Sheriff's responding officer showed the horizontal side shaft along the manure box was bent at the bearing in the middle of its length. The chain at the rear end of the side shaft was disconnected. The chain driving the bottom conveyor was off its sprocket. The chain for the beater was still in place but worn and loose. It is not known whether the chains came off before or during the incident or were taken off during the extrication. Moving parts in the gearbox area appeared clear of oil and dirt, consistent with the victim's clothing being entangled and wrapped in them. No guarding for these drive components was present at the time of the incident.

CAUSE OF DEATH

The cause of death according to the preliminary medical examiner's report was crushing injuries to the rib cage resulting in compressional asphyxiation.

RECOMMENDATIONS / DISCUSSION

Recommendation #1 *Tractor operators should disengage all PTO-powered mechanisms and stop the tractor's engine before leaving the tractor operator's station, or get assistance from a coworker to inspect moving machinery parts from a safe distance.*

Discussion: Operator manuals provided by manufacturers of tractors and implements recommend safe operating procedures and they should be followed. When operating mobile PTO-powered machines, the operator should never leave the tractor seat until the PTO is disengaged, the tractor transmission placed in neutral or park, the park brake engaged, the tractor's engine shut off, and the ignition key removed. Operators should never attempt to adjust or unplug a PTO-powered implement with the engine running or the PTO in operation.

When it is essential to inspect moving machinery parts of drives, or functional components such as beaters and conveyors, two people should be involved. The tractor operator should remain in the operator's seat to operate the machine very slowly, stop moving parts quickly, and maintain effective communication with the person observing the machine's operation. The observer should remain a safe distance away from the machine where there is no danger of becoming entangled in the operating mechanism. When determining a safe distance, workers should consider material that could be thrown, such as manure from a spreader's beater paddles.

Recommendation #2 *Powered moving machinery parts of agricultural equipment should have the manufacturer's recommended guarding in place and maintained to perform its intended function.*

Discussion: Voluntary consensus standards describe guarding and safety signs for agricultural field and farmstead equipment provided by machinery manufacturers. The apparent old age of this manure spreader indicates it was manufactured prior to the latest revisions of current standards. The exact warnings and guarding in place when the manure spreader in this incident was originally produced are not known. All shields over moving machinery parts must be kept in place, maintained, and function properly during machine operation. Extra care to ensure that workers are a safe distance from exposed moving mechanisms should be used when using older machines that may have been manufactured without guards. Owners and operators should check with implement dealers to find out if retrofit guards for older equipment are available from implement manufacturers.

Recommendation #3 *Operators should avoid wearing loose-fitting clothing or clothes that have loose or frayed ends that could be caught in moving machinery parts.*

Discussion: Operators working around machinery may not pay close attention to loose-fitting clothing, drawstrings, shoe laces, frayed seams, or loose hair. These can dangle and sway in the wind or as an operator moves about in their work tasks. Preventing such loose gear should be a priority beginning with the choice of clothing for the day or work period. Operators should dress in close-fitting, well-maintained clothing without drawstrings or other parts that could catch on something or become entangled.

Recommendation #4 *Machinery should be maintained to minimize breakdowns and interruptions of work tasks.*

Discussion: In many cases, injuries involving machinery occur during an unexpected interruption in work tasks, such as that due to a machine malfunction or failure. Operators can be tired, fatigued, distracted, in a hurry, and otherwise stressed in ways leading to greater risk taking, such as leaving the tractor with the engine running and PTO engaged. The responding officer's investigation photographs showed the manure spreader in this incident had considerable corrosion, wear, and damaged structural elements around the box and beater. There was a thin metal bar welded across the back of the manure box and a patch bolted to its side near the beater. The bearing for the beater appeared recently changed, suggesting some repairs had been done. However, repairs appeared limited to what was needed to spread manure rather than encompass what could have been done to restore guarding, trouble-free performance, and increase the likelihood for safe operation. Operators should follow preventive maintenance practices, such as keeping the conveyor apron chain in good working condition, to prevent malfunctions that require repairs in the field or contact with the spreader such as the need to manually unload it.

REFERENCES

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Fatality Assessment and Control Evaluation
FACE

Fatality Assessment and Control Evaluation, FACE, is a program of the *National Institute for Occupational Safety and Health* (NIOSH), which is part of the *Centers for Disease Control and Prevention* of the *U.S. Department of Health and Human Services*. Nationally, the FACE program identifies traumatic deaths at work, conducts in-depth studies of select work deaths, makes recommendations for prevention, and publishes reports and alerts. The goal is to prevent occupational fatalities across the nation.

The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE case surveillance and evaluation program and also funds state-based programs in several cooperating states. In Iowa, *The University of Iowa* through its *Injury Prevention Research Center* works in conjunction with the *Iowa Department of Public Health* and its *Office of the State Medical Examiner* to conduct the Iowa FACE program.

Nationally, NIOSH combines its internal information with that from cooperating states to provide information in a variety of forms which is disseminated widely among the industries involved. NIOSH publications are available on the web at http://www.cdc.gov/NIOSH/FACE/ and from the NIOSH (1-800-CDC-INFO (1-800-232-4636) or email cdcinfo@cdc.gov).

Iowa FACE also publishes its case studies, issues precautionary messages, and prepares articles for trade and professional publications. In addition to postings on the national NIOSH website, this information is often posted on the Iowa FACE website at http://www.public-health.uiowa.edu/FACE/. Copies of FACE case studies and other publications are also available by contacting Iowa FACE directly.

The Iowa FACE team includes the following specialists from the University of Iowa: Craig Zwerling, MD, PhD, MPH, Principal Investigator; John Lundell, MA, Co-Investigator; Murray Madsen, MBA, Chief Trauma Investigator; and Co-Investigator/specialists Risto Rautiainen, PhD, and Wayne Sanderson, PhD, CIH. Additional expertise is provided from the Iowa Department of Public Health, including Rita Gergely, Principal Investigator, and John Kraemer, PA, from the Office of the State Medical Examiner.

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