

## CHAPTER 11

# WORKER SAFETY AND HEALTH

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The management practices that we use when it comes to manure handling and storage changes along with the ever-changing world. As the practices get more sophisticated, so do the equipment and storage structures. The purpose of this chapter is to describe common safety concerns on livestock and poultry farms. The various topics are: pumps and agitators, confined spaces, respirators, and ladder safety.

### PUMP AND AGITATOR SAFETY

Pumps and agitators are typically used to manage solids in manure storage structures and lagoons. Several safety issues arise from their use. These pieces of equipment are typically powered by a tractor power take off (PTO) shaft or an electric motor. Each have their own list of safety concerns.

#### **PTO Safety**

A PTO driven pump/agitator has its power supplied by a tractor. Due to this arrangement, there are several issues that must be addressed concerning safety; PTO safety and tractor safety.

When working around PTO shafts, loose fitting clothing that may become entangled in a rotating shaft should not be worn. Long hair and loose shoestrings can also be easily entangled. The reaction time of a person compared to the speed of a turning PTO shaft is slow. Before you have time to react, you can be caught in the spinning shaft. Death or loss of limb may be the consequence of entanglement.

Due to these hazards, protective shields and guards should always be used. A retrofit shield is recommended on older equipment that may not have these protective shields. Always use caution around a PTO shaft, even with a proper shield. Do not lean over or step over a turning PTO shaft.

The PTO shaft and shields should be examined to ensure that they are not rubbing on any surrounding part of the tractor or are not in a position to bind. Proper PTO hitch length is also important to assure that the shaft does not come apart, which could result in severe injury. Proper hitching can eliminate these problems.

Always disengage the PTO shaft, shut off the tractor and remove the key prior to servicing any type of PTO driven equipment.

## **Tractor Safety**

Tractor rollovers are the single largest cause of agriculture related deaths.

The rollover protective structure (ROPS) protects the tractor operator by preventing the tractor from crushing the occupant if it rolls over. The weight of the tractor now rests on the ROPS rather than on the operator. When operating a tractor with a ROPS in place, the seat belt must be worn or the operator may be pinned under the ROPS if the tractor rolls over. The seat belt keeps the operator in the protective zone of the ROPS. No seat belt should be worn when operating a tractor that is not equipped with a ROPS.

The next safety issue concerns passengers. The rule for extra riders is “No Seat, No Rider”. An extra rider can easily fall off and possibly be run over. If a rollover occurred, the passenger could be crushed.

Another problem associated with tractors is bypass starting the tractor (shorting the starter) or starting the tractor from the ground. When starting the tractor from shorting the starter, severe injury can result if the tractor is in gear. Once the engine starts, the tractor can move forward and crush the person starting it. This is due to the location of most starters in relation to the rear wheels. Many equipment manufactures now provide covers for the starter to prevent this from occurring. Also, never start the tractor from outside the seat. If the tractor is in gear or the PTO is engaged, the equipment can begin running and cause injury to an unsuspecting bystander.

Agitation and pumping of manure from a storage structure or lagoon typically requires backing a tractor down an embankment or ramp. When performing this maneuver, be sure the ramp is not too steep, and take it slow. Once in place, make sure the wheels are chocked to prevent equipment from rolling into the storage structure. Before engaging the PTO drive, be sure tractor is out of gear and the parking brake is set.

## **Fuel Safety**

There are several precautions for equipment that is powered by a gasoline or diesel engine. The engine needs regular maintenance to stay in proper working condition. With all fuel burning equipment, carbon monoxide (CO) in the exhaust is a potential threat. Be sure the area where the engine is serviced is properly ventilated. With any fuel, there is a potential for fire. Keep fuel in approved storage containers and away from any source of sparks or high temperatures.

## **Electrical Safety**

Another source of power for pumps and agitators is electricity. One risk that is associated with electricity is electrocution. Be sure all motors are properly grounded and all wiring is protected and in good condition. Electric motors should be rated for high moisture and dust conditions. All electrical lines should be marked to prevent any possible abrasion of the insulation. Any overhead power lines should be located so as not to interfere with daily operations.

## **Agitator Safety**

Agitating animal manure can release various harmful gases. These gases can be fatal. The storage area should be free of any person or animal during this process. If entry is necessary, a self-contained breathing apparatus (SCBA) must be worn.

### **Agitator/Pump Safety Quick Facts**

- Master shield should always be in place. When master shield has to be removed for implement hook-up, implement guarding needs to shield PTO shaft as well.
- Before using, always inspect shields and guards, make sure they are in proper working condition and replace any damaged parts.
- Safety labels should be in place and visible.
- Do not wear loose fitting clothing or articles that might get caught in a turning PTO shaft and watch out for loose shoestrings.
- Do not step over or lean over a turning PTO shaft.
- If performing maintenance on a piece of equipment, disengage the PTO shaft and shut off the engine.
- No Seat No Rider.
- If equipped with a ROPS, make sure that seat belt is worn.
- Rollover Prevention
  - Avoid depressions or holes.
  - Do not drive too close to a ditch bank.
  - Use proper hitch points.
  - Use caution while on steep hillsides.
  - Avoid excessive speeds in turns.
- Be aware of where bystanders are located.
- Follow proper procedures when traveling on roads (lock brake pedals).
- Chock wheels when positioning the pump or auger to prevent rolling.
- Keep fuel in approved containers.
- Make sure all motors are properly grounded and all wiring is protected and in good condition.
- Fatal gases can be given off during agitation, so the area should be clear of any person or animal.

## **CONFINED SPACE SAFETY**

A confined space is an area with limited access that is designed for limited occupancy. It is large enough to work in but is not intended to be a work place. Examples of confined spaces include silos, grain bins, manure pits, and above ground storage tanks (Gempler's, 1997).

There are several hazards associated with these structures. A confined space may contain gases that can be fatal. Some common gases associated with decomposing manure found in

agricultural confined spaces are hydrogen sulfide (H<sub>2</sub>S), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), or ammonia (NH<sub>3</sub>) (Purschwitz, 1996). Another common gas associated with agricultural confined spaces is carbon monoxide (CO). The following are descriptions of common characteristics of gases and the associated side effects.

### **Ammonia (NH<sub>3</sub>)**

Ammonia is associated with manure pits or above ground tanks where manure is stored. It has a sharp pungent odor that can cause eye and respiratory irritation.

### **Carbon Dioxide (CO<sub>2</sub>)**

Carbon dioxide can be found in grain bins, manure holding structures, or silos. CO<sub>2</sub> is colorless, odorless, and tasteless. It displaces oxygen in the blood resulting in headaches, drowsiness, and death.

### **Carbon Monoxide (CO)**

Carbon monoxide is a by-product of burning fossil fuel and has similar characteristics as that of carbon dioxide. It is colorless, odorless, and tasteless. It also displaces oxygen in the blood and results in the same conditions. It can be found in animal facilities where heaters or engines are used.

### **Hydrogen Sulfide (H<sub>2</sub>S)**

Hydrogen sulfide is formed when anaerobic microbes decompose manure and can be found around manure-holding structures. Hydrogen sulfide has an odor similar to rotten eggs and can be smelled at low concentrations. At higher levels, the sense of smell is overwhelmed. At these levels, one cannot rely on just his/her sense of smell. It can cause eye and nose irritation, headaches, nausea, and death.

### **Methane (CH<sub>4</sub>)**

Methane gas can be found around manure-holding structures and is formed when manure decomposes anaerobically. This gas is non-toxic but is flammable and can be explosive. Methane may be considered non-toxic, but at high enough concentrations displaces oxygen and causes suffocation.

Table 11.1. Recommended exposure limits of some common gases found in animal operations.

Gas	Odor Threshold (ppm)	Exposure Limits (ppm)	
		Maximum Allowed Average Concentration <sup>a</sup>	Immediately Dangerous Concentration
Ammonia	5 <sup>c</sup>	25 <sup>d</sup>	300 <sup>e</sup>
Carbon dioxide		5000 <sup>e</sup>	40000 <sup>e</sup>
Carbon monoxide		50 <sup>e</sup>	1200 <sup>e</sup>
Hydrogen sulfide	0.7 <sup>c</sup>	10 <sup>c</sup>	20 <sup>e</sup>
Methane		1000 <sup>d</sup>	

<sup>a</sup>Time weighted average for 8 hours.

<sup>b</sup>Maximum allowed short term limit, 15 minute average.

<sup>c</sup>Midwest Plan Service

<sup>d</sup>Northeast Regional Agricultural Engineering Service

<sup>e</sup>National Institute of Occupational Safety and Health

## Confined Space Entry

With the hazards that one faces upon entering a confined space whether it is gases or trapping and suffocation, proper warnings should be displayed around these areas. An example of such warning may be a sign that says; DANGER—CONFINED SPACE, DO NOT ENTER. Openings to confined spaces should be inaccessible to unauthorized persons. Fences should be used around in-ground storage areas. Ladders should be inaccessible for children and unauthorized personnel near above-ground storage areas.

Ventilation should be used before entry into confined spaces due to the potential for gas accumulation. Personal protective equipment (PPE) should be available for use for entry into a confined space. One should not enter a confined space without a proper breathing apparatus unless the area has been tested safe.

A proper self-contained breathing apparatus (SCBA) not only supplies air, but also seals out harmful gases. Special training is needed to use a SCBA. When entering a confined space, along with wearing a SCBA, a retrieval system must be used. This system consists of a chest or body harness, a retrieval line, and another person.

At least two people are required for entry into a confined space. Both people need to understand the hazards they face, including information on the symptoms and consequences of exposure. They also need to know how to properly use their safety equipment. One person needs to remain on the outside, while one is inside. Communication between persons must be maintained. At least one person, other than the one entering the confined space, should know first aid and CPR.

Only trained persons should enter if someone needs to be rescued from a confined space. There have been numerous incidents where there have been multiple fatalities when untrained persons have entered an area.

## Confined Space Safety Quick Facts

- Identify any confined spaces that are in your operation.
- Confined spaces should be constructed to prevent any unauthorized person from entering.
- Post warning signs at each confined space warning of the dangers.
- Persons entering a confined space should have proper training.
- A self-contained breathing apparatus (SCBA) should be used for entry into a confined space.
- One person must remain outside the confined space while one is inside.
- Communication links should be maintained while one is inside.
- Knowledge of the gases and their properties should be understood by individuals entering a confined space.
- A chest or body harness and life-line must be used.
- Provide ventilation to a confined space before entry.
- Have someone available trained in first aid and CPR.

## RESPIRATOR SAFETY

There are many different environments on the farm that require the use of respirators to protect worker health. The type of respirator must be matched to the hazards in the environment. Respirators either supply clean air to breathe or purify the air that is inspired.

An air-purifying respirator uses a cartridge or canister to remove specific contaminants. Cartridges and canisters use filters, sorbents, catalysts, or combinations of these materials to remove specific contaminants from the air as it is passed through. Another type of respirator supplies the user with air that is independent of the work environment. One form of this respirator is the self-contained breathing apparatus (SCBA). All respirators should be NIOSH approved and used in compliance with the conditions of its certification.

A full face pressure demand SCBA certified by NIOSH for service life of 30 minutes must be used if the environment is an immediate danger to life and health (IDLH) or if there is a lack of oxygen. A SCBA or an air-purifying respirator with cartridges certified by NIOSH for the contaminant(s) present (cartridges are labeled by contaminant) must be used for non-IDLH gases and vapors. A SCBA or an air-purifying respirator with cartridges certified by NIOSH for particles (includes HEPA) must be used for particulates. Fit testing and proper cartridge selection (for air-purifying respirators) are critical in all cases. A dust mask is not really a respirator and is intended for nuisance rather than dangerous exposure (OSHA, 1998).

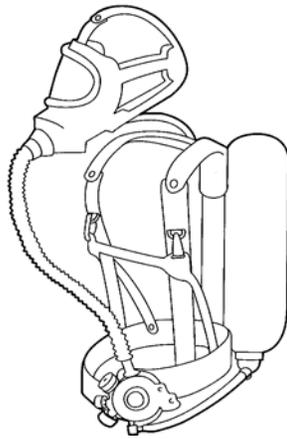


Figure 11.1. Self Contained Breathing Apparatus (NRAES, 1998).

### Questions to Understand

- What environment are you entering?
- What kind of respirator is appropriate?
- Do you know how to inspect, put on and remove, use, and check functionality of the respirator?
- Do you understand the medical signs and symptoms of the potential gas or environment that you might be entering?
- What do you do if a respirator malfunctions?
- Do you know how to maintain and keep a respirator in clean and good working condition?

## PATHOGENS

Pathogens become important in manure when the host (human or animal) is exposed to greater numbers of organisms than normal in their environment or to organisms not normally found in their environment. A pathogen is defined as any virus, bacterium, or parasite capable of causing infection or disease in livestock animals or humans (Stehman, 1996). The following section briefly discusses a few of the more common pathogens potentially found in manures and precautions that should be taken.

### Parasite

*Cryptosporidium parvum* and *Giardia* are the most important parasites shed in animal manure. These parasites can be transmitted to humans.

### Bacteria

#### *Salmonella*

*Salmonella* species are some of the most common pathogens shed in poultry, swine and ruminant manure. These organisms cause infections across livestock host groups and in humans. Aerobic storage, low pH and higher temperatures in the summer all decrease salmonella survival.

### *Campylobacter jejuni*

*C. jejuni* is one of the leading causes of diarrheal illness in humans. Survival is limited by low pH, aerobic conditions, drying, and heat.

Table 11.2. Some pathogens found in livestock manure.

<b>Parasites Shed in Manure</b>	<b>Human Consequences</b>
<i>Cryptosporidium parvum</i>	diarrhea
<i>Giardia</i>	diarrhea
<b>Bacteria Shed in Manure</b>	
<i>Salmonella spp.</i>	diarrhea
<i>Campylobacter fetus, C. jejuni</i>	diarrhea, intestinal cramps, fever
<i>Listeria</i>	flu like symptoms, meningitis, abortion
<i>E. coli</i>	diarrhea, septicemia, toxemia, meningitis
<i>Tetanus</i>	muscle contractions (face and neck), lockjaw

### **Population at Risk**

Pregnant women, people with poor circulation or diabetes, or persons taking immunosuppressant drugs should be extra cautious when working around or handling manure. Simple wounds can easily be infected.

### **Precautions**

Persons working around or handling manure should take proper precautions. Proper precautions include wearing heavy rubber gloves (personal protection equipment), washing (personal sanitation), and keeping existing wounds and/or fresh wounds clean. Other precautions include vaccinations such as *tetanus* shots. *Tetanus* vaccinations are good for ten years.

## **LADDER SAFETY**

Falls are sometimes overlooked when it comes to injuries sustained from work-related incidents. In agriculture, equipment and tractor related injuries often take center stage. Falls do occur and take place in various situations ranging from falling off a tractor to falling from an above ground manure storage structure, silo, or grain bin.

Several steps can be taken to prevent falls and injuries on equipment such as tractors and combines. Always use handrails to climb on or off and watch your step. Also, keep the steps and platforms free of mud and debris that might cause you to slip and fall. Falls from just a few feet can result in severe injury.

Ladders are typically the means by which a person ascends or descends structures such as silos, grain bins, above-ground manure storage tanks, etc. Therefore, ladders must be designed and

installed correctly to reduce the risk of injury to a person who might be working on such a structure. Refer to ASAE Standards S412.1 (ladders, cages, walkways and stairs) for proper ladder design.

### **Ladder Safety Quick Facts**

- Be sure all ladders are designed and installed properly.
- Be sure safety harnesses are available and in proper working condition.
- When using a safety harness, make sure someone else is nearby to provide help if needed.
- When entering a structure, refer to safety precautions associated with that structure.
- Be sure ladder rungs or steps are clean of mud or debris that might cause a slip or fall.
- Use handrails, and watch your step.

### **References**

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