In many ways, gypsum seems to be an excellent material as a bedding source on dairy farms. It is cost effective, absorbs moisture, improves traction, reduces ammonia losses, potentially saving nitrogen for use by crops, and is a source of calcium and sulfur for crop fields. However, one major area is a concern, and this is one well worth paying attention to and taking extra precautions for if gypsum is used on your farm. In some conditions gypsum may increase formation of a toxic gas called hydrogen sulfide. In daily spread operations, the risk seems to be quite low, but when gypsum is used in conditions where oxygen is limiting, such as stored liquid manure or bedded packs, the risks can be serious and even life-threatening.

In some conditions, concentrations of hydrogen sulfide released during manure handling may be high enough to cause injury or death to workers or family members nearby. Fortunately, gas concentrations are rapidly diluted with distance from the manure pit or barn, so there should be little or no concern during agitation or clean-out beyond the immediate farmstead.

All stored manure can produce gas levels of concern in some conditions. Some gases (like hydrogen sulfide) are toxic and heavier than air and therefore are prone to sink to low areas like storage pits, sumps or other depressions. Because of this, these areas are the most dangerous and children and small animals are especially at risk. When mixed before spreading, manure pits and storages that hold manure from barns where gypsum is used in or for cow bedding may be at increased risk to release hydrogen sulfide gas at levels that are hazardous and could even be life-threatening. As wind currents mix hydrogen sulfide with air, the hazard is quickly reduced so the main concern is the area right around manure storage, especially during agitation.

Why is gypsum a potential concern? Gypsum is a significant source of calcium and sulfur. Though both calcium and sulfur are beneficial in the right place and form, some naturally occurring bacteria in liquid manure storages or bedded packs (especially if deep) use the sulfur to make hydrogen sulfide. The bacteria are most active in warmer months, so summer and fall pit agitation can be more dangerous.

In October and November 2013, staff from a Central New York fire department and Soil and Water Conservation District (SWCD) measured hydrogen sulfide levels at a number of farms that use gypsum for bedding and those that do not. In every case, cleanout at farms that use gypsum had much higher levels of hydrogen sulfide in the area where manure was mixed or handled. At farms where gypsum was not used for bedding, readings around manure storage during agitation was mostly non-detect or a few ppm for hydrogen sulfide.

In one situation, more than 200 ppm hydrogen sulfide was measured next to a long-term manure pit.
storage pit during agitation on a farm where gypsum was used for bedding. Hydrogen sulfide levels were over 100 ppm in a deep bedded pack barn that was being cleaned out, showing that this is an area of high risk. Packs are normally under a roof and enclosed barns may not provide enough air movement to maintain safe working conditions. While hydrogen sulfide typically sinks to low areas, testing during windy conditions at earthen storages with sloped sides show higher numbers four to five feet off the ground as the wind ramps the gas upwards. On calm days with no wind, gas will settle in low areas, making potentially dangerous conditions hours after pump-out.

In certain conditions, hydrogen sulfide can be a problem in any long-term storage, but the level found here is much higher than we have seen measured in other locations. It is not fully clear if gypsum is the sole source of the problem, and more testing is needed to better assess the situation. However, gypsum is a major source of sulfur in some pits and due to the potential threat to health and safety, we recommend caution. A few pounds per week of sulfur from gypsum does not sound like much, but may be enough to significantly increase hydrogen sulfide production in anaerobic conditions.

Hydrogen sulfide levels above 20 ppm can begin to cause problems including headaches, dizziness, and fatigue. According to the Occupational Safety and Health Administration (OSHA), a concentration of 100 ppm hydrogen sulfide is immediately dangerous to life and health because the symptoms can make it hard to escape from a dangerous situation. Levels exceeding 100 ppm paralyze the human olfactory nerve (sense of smell) preventing the exposed person from recognizing the danger, and exposure at this level for 48 hours may cause death. At levels above 500 ppm, staggering and collapse can occur in five minutes, death after 30 to 60 minutes. If we are finding random air samples over 200 ppm, it is possible to have pockets of hydrogen sulfide near storage structures during agitation that are at much higher levels.

Farmers who store manure with gypsum material and plan to agitate and land-apply manure from that storage, take the following precautions:

• Make sure no unnecessary people are near the pit or open air storage during agitation and pump-out.
• Alert a family member or employee that you may be entering an area with dangerous levels of gas.
• Pay attention to wind direction and low areas where dangerous gases may pool. If your pump-out location is in a low area, consider moving it to a different spot.
• Set up large fans and/or blowers around where operators will be working to mix fresh air and dilute any gases.
• Pit operators should be trained to use respirators and how to work in hazardous places.
• Use a respirator when working around the pit during agitation and filling.
• Do not enter pits, tanks or open air depressions (low areas) without a respirator!
• If entry is necessary, never do so during agitation. Enter only if the agitation pump is turned off, the pit is well-ventilated, fresh air is supplied to a respirator, a safety harness and attached rope is worn, and two people wearing respirators are standing by to help.

When cleaning out a barn’s bedded pack manure:

• Make sure no unnecessary people are near the pack, especially at the location where the pack is being removed.
• Alert a family member or employee that you may be entering an area with dangerous levels of gas.
• If hand clean-out is required, consider wearing a beltmounted personal gas exposure alarm system to alert you if exposure is exceeding safe limits.
• Open all barn doors, windows, curtains and any other air inlets/outlets if the barn is naturally ventilated or turn on the mechanical ventilation system to full capacity before beginning the clean-out process.
• Set up large fans and/or blowers around where operators will be working to mix air and dilute any gases.

In addition to the above tips, farmers should:

• Consider using other materials for bedding until this issue is better understood.
• Have an emergency plan in place.
• Train all family members and employees in the dangers of manure gases.
• Install gating/fencing and danger signs around all manure storages.