

Manure Storage Design and Safety Considerations with Gypsum Bedding

Surprise! Open-air, outdoor manure storages pose dangers even with all that fresh air around. A number of recent human tragedies in the vicinity of mixing and cleanout of outdoor manure storages raised concern.

A series of investigations by farmers, manure haulers, Penn State Extension personnel and industry leaders identified that gypsum-laced manure was capable of creating deadly levels of gas emissions, specifically hydrogen sulfide gas [H_2S]. The gypsum, a.k.a. calcium sulfate, was a residual in the manure from its use as a beneficial bedding material in the dairy barn. This fact sheet outlines practical design considerations of manure storages and management for safely working during manure agitation events on dairy farms using gypsum bedding.

Under-barn manure Storage

Our unconditional recommendation is to not use gypsum bedding with under-barn manure storage. Potential is very high for release of extreme concentration of H_2S when manure is moved or mixed, resulting in harm to barn workers and confined cattle.

Operator-position during agitation



During any manure movement or mixing, operator must be up above the ground and away from edge of a manure storage. Particularly with manure containing gypsum bedding material, H_2S gas at lethal levels (>600 ppm) is quickly produced and undetectable by smell. Hydrogen sulfide is a heavy, ground-hugging gas.

Position work area so operator:

- Does not reach over the storage for routine practices

- Does not work or need to adjust machinery near storage edge
- Is not in a low-lying area

Wind Direction

Hydrogen sulfide can settle in windless areas, shelterbelts or among buildings blocking airflow near a storage unit. Strong breezes will move H_2S out and away from storage, diminishing risk. Operators should be positioned upwind.



Access during agitation

Once manure storage agitation begins, no one should be in the immediate area. Encourage casual onlookers to keep well away (minimum of 50 feet). Children, pets, calves, and resting cattle are more susceptible due to lower breathing zones. Low areas accumulate H_2S so operators, other people and animals should avoid any nearby depressions.

Planning layout



Gases “throw” in the direction of a manure agitator nozzle, so be aware of dangerous impact on “downwind” animal or



human occupied areas. Confined cattle in the area are at risk.

Confined manure storage

Long ago it was discovered that confined spaces accumulated dangerous levels of manure gases (sumps; low areas; gutters; cross channels; pits; pump out access areas; underfloor manure storages). Dangerous gas levels are especially common during agitation of the manure. The addition of gypsum bedding makes this an even greater hazard with the potential for high H_2S levels.



Take Home Points:

- Manure movement and mixing will almost certainly cause dangerous level of H_2S gas release from manure that contains gypsum bedding.
- Avoid being anywhere near the manure storage during agitation events and consider impact on occupants of nearby surroundings.
- Up and away. Operators positioned above surrounding topography and at a distance from the storage are at reduced risk for experiencing dangerous H_2S gas levels versus operators positioned nearby at ground-level. Operators should be positioned upwind.

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