Department of Animal Science

PREVENTING FIRES IN POULTRY LITTER STACKING SHEDS

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Storing poultry litter in a covered storage structure is a valuable, well-proven, environmentally sound best management practice. A litter stacking shed preserves the nutrient content of the litter. It also allows the litter to be stored in a secure environmental manner that protects surface and groundwater quality. Litter storage allows flexibility timing land application of litter to coincide with crop and forage nutrient demand. The structure also provides protection from rainfall, keeping the material dry. In short, a litter stacking shed is a critical part to a poultry farm's overall farmstead and nutrient management program.

However, **there is a risk of fire associated with litter stacking sheds**. Proper management practices can lessen this risk, but growers should be mindful that the fire danger is real and must be guarded against continuously. Failure to implement good litter stack management practices can result in overheating and spontaneous combustion of stored litter and possible loss of the stacking shed from the resulting fire.

Recognize the fire danger

It has long been recognized that heat is generated and temperatures increase significantly when microbiological activity occurs in an insulated environment, such as a large stack of poultry litter. Litter is home to a diverse microbial population, and as microbial activity occurs within the litter, heat and methane gas are produced. Heat is also generated chemically at the boundary layer between moist litter and dry litter in the storage pile. As a result, spontaneous combustion (self-ignition) can occur in a litter pile especially if temperatures climb above 190 F.

Figure 1. Litter stacked over 7 feet high in a stacking shed. Sidewall is 5 feet high.

Figure 2. Litter overheated and caught this stacking shed sidewall on fire.

Figure 3. Overheated litter can reach the flashpoint of wood and start a shed fire.

Figure 4. Lumber and posts destroyed by overheated litter in a stacking shed.

Litter that is stacked too high at the walls of the shed can ignite the walls if the temperature in the litter reaches the flash point of the wood (Figures 1-4). Litter that is stacked **too high can also spontaneously combust because of excess heat and methane buildup** within the stack. It is a similar process to the spontaneous combustion of hay bales or silage stored in barns or silos; however, less is known about the spontaneous combustion of poultry litter. One thing we do know is that **litter should not be compacted**, so do not drive a tractor on stored litter because this compacts the litter and increases the likelihood of a fire (Figure 5). It is a good idea to use a compost thermometer to frequently monitor litter temperature (Figure 6).

Figure 5. Do not drive a tractor on stored litter to prevent compaction and greater risk of fire danger.

Figure 6. Use a compost thermometer to frequently check litter temperatures.

Spontaneous combustion occurs more often than many people realize. Overheating and spontaneous combustion in hay barns, landfills, coal piles, and containers of oily rags are somewhat common occurrences. There are likely both biological and chemical factors at work with poultry litter storage fires, although the exact causes are not well understood. Fires and explosions have occurred before in sanitary landfills that produce combustible methane. Conditions must be right for the growth of anaerobic bacteria that produce methane. These conditions include an **oxygen-free or very low-oxygen environment and a moisture content greater than 40 percent**. This is often the case when fresh litter (especially caked litter) is added to the stacking shed, especially if it is compacted in order to store more litter than the shed should hold.

Methane has is less dense than air and, therefore, can readily rise and escape to the atmosphere given a pathway (i.e., adequate pore space in the surrounding litter). Unfortunately, litter that has been compacted by being driven on with a tractor, or is simply stacked too high, may no longer have adequate pore space to vent methane. As a result, methane concentration can increase to a point where it is flammable in the air, at **concentrations as low as 5 to 15 percent**.

Like compaction, mixing dry and wet litter is never a good idea and can also lead to spontaneous combustion. When dry litter comes in contact with moist litter, the dry litter absorbs moisture and heat is generated. As a result, the area between the new and old litter becomes a heat production zone. The higher the litter is stacked, the greater the potential for significant heat generation. If this heat cannot escape, the temperature inside the stacked litter can increase significantly. **Microbial activity plays a large role early on in heat generation, but this role decreases** over time because most bacteria are killed between 130 F and 165 F. **Chemical reactions are likely responsible for continued heating beyond 165 F and likely cause the actual combustion** as temperatures climb to 190 F and higher.

Risk factors

A combination of several factors is often present when a poultry litter stacking shed fire occurs:

1. **Moisture.** Moisture is likely the most critical factor in stacking shed fires. Dry litter does a poor job of heat generation and retention, but wet litter does a very good job of both producing and retaining heat. Once litter is stored and the composting process begins, moisture evaporates or is used by the microbial population and heat is generated. Likely the most common mistake that producers make is adding moist litter to dry litter that has been in the shed for a while. The area where the two zones meet becomes a favorable environment for anaerobic bacteria growth. As they grow, anaerobic bacteria generate gases that are composed of about 50 to 65 percent methane, 30 percent carbon dioxide, and a smaller percentage of other gases (Hess et al., 2018). If the moisture content of the litter in the shed is more than about 40 percent, with little or no available oxygen, anaerobic bacteria will thrive and produce an abundance of methane gas. Litter added to the stack at less than 40 percent moisture lessens the risk of methane production and overheating, while litter added at greater than 40 percent moisture increases this risk. If

the stacked litter has not been compacted and has adequate pore space, the methane gas that is produced will have a vent to the atmosphere and will not build up in the litter. Realize that litter always has active microbial populations that generate heat as a result of their activities. In certain ideal situations, a combination of this microbial heat production and chemical reactions within the litter cause spontaneous combustion in litter to occur.

2. **Layers of dry and wet litter.** Stacks that contain litter that is layered either horizontally (new wet litter stacked on old dry litter) or at an angle (new wet litter pushed against the sloping sides of old dry litter) pose a risk. The boundary where these layers meet becomes a methane and heat production zone. The larger the stack, the greater the risk of overheating and spontaneous combustion.
3. **Stack size.** The size of a litter stack affects heat production and heat release. Height (in particular) and width are more important than length. Higher and wider litter stacks increase the risk of excessive heat production and fire, whereas smaller stacks provide a larger surface area for heat release and lower the risk of fire. Litter in a stacking shed should never be stacked more than 7 feet high at the center and no more than 4 feet high at the walls.
4. **Compaction.** Compaction encourages anaerobic conditions in litter. Compacting also tends to trap both methane and heat within the litter stack by lessening the available pore space and vents for dissipating heat and methane. Do not drive a tractor over the litter in a staking shed.
5. **Caked litter.** Many producers add caked litter to their stacking sheds between flocks, but this can be risky. Decaked litter is often wet litter that can increase risk of fire danger, especially when added to dry litter already in the shed. Caked litter should be separated from dry litter in the stacking shed until it has had a chance to dry.

Best management practices

- Invest in a compost thermometer so you can frequently monitor litter stack temperatures — this can alert you to an increased risk of fire and prevent loss of the stacking shed.
- Stacked litter **temperatures of 160 F or less are considered normal**. Temperatures above 160 F require closer attention and increased caution. If the litter temperature reaches 180 F, the material should be removed from the shed.
- If stacked litter reaches **temperatures near 190 F or if the stack begins to smolder, the material should be immediately removed** from the shed. Be extremely careful when breaking into the pile because **disturbing a smoldering litter stack can expose it to increased oxygen and start a fire**. Having the fire department on hand before disturbing a smoldering litter stack is recommended.
- If the smoldering material is land applied, **make sure it does not catch the field on fire**.
- Do not store expensive farm machinery in a litter stacking shed — this can greatly increase the liability incurred if there is a fire.
- **Never stack litter over 7 feet high at the center or 4 feet high at the walls** of the shed.
- Do not layer wet litter on dry litter.
- Separate wet caked litter from dry litter in the shed until the wet litter can dry.
- Do not compact litter in the shed.
- Protect litter in the shed from wind-driven rain, which otherwise can add moisture to litter and increase the fire risk.

Summary

Litter stacking sheds are an important part of nutrient management programs for broiler farms across the country. Stacking sheds lessen the possibility of polluting surface and ground waters and improve flexibility in timing land application of poultry litter. However, litter stacking shed fires are a real possibility if the best management practices discussed herein are not followed. Spontaneous combustion is possible, particularly if litter is stacked over 7 feet high in center of the shed or 4 feet high at the walls. Litter moisture content is a critical factor in shed fires. Compacting litter in the shed, layering wet and dry litter together, and not separating new caked litter and old dry litter increase the risk of fire. **Frequent temperature monitoring of litter in the shed and proper precautions will greatly reduce the risk of a stacking shed fire and keep your litter shed intact for many years to come.**

References

Hess, J. B., J. O. Donald, and J. P. Brake. 2018. Preventing fires in litter storage structures. Alabama Cooperative Extension Service Publ. No. ANR-0915.

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