

THE BURNING BALE

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Cutting and baling hay is not new, although the methods continue to evolve. Agrarian people have always harvested and stored hay and other crops to feed animals in winter and times of drought. Consequently, the phenomenon of stacks or bales of hay bursting into flames—spontaneous combustion—has been a mystery to many, and has resulted in the loss of crops, property, equipment, and lives.

Each year, beginning in late spring, hay producers begin baling their first cutting of hay. The primary goal of producers is to allow cut hay to dry to an optimum moisture level of less than 20 percent before baling. Because the highest yield of the season is on the first cut, it takes longer for the hay to dry due to the bulk. In addition, spring is typically a wet and cool season. These factors present a significant challenge to producers, who want to get the first cutting baled and stored, and the second hay crop up and growing.

Hay should be dried sufficiently before baling. Wet hay loses forage quality, and produces molds which consume plant sugars and cause loss of dry matter and digestible nutrients. When hay heats beyond 100°F, browning (or caramelization) will occur. Wet hay also produces internal heat within the hay bale that may result in spontaneous combustion.

SPONTANEOUS COMBUSTION

Plant and mold respiration generate lots of heat. Allowing cut hay to dry (or cure) will slow down the respiration process. Plant respiration slows as moisture content decreases but does not stop until plant moisture is 20 percent or less. Moisture levels above 20 percent allow the respiration process to continue and mold to develop, producing heat.

When the internal temperature of a hay bale exceeds 130°F, a chemical reaction releases

flammable gases that can ignite if the temperature is high enough.

MONITORING TEMPERATURE

Although it's not unusual for the internal temperature of the hay bale to reach 100 to 130°F before beginning to cool, the hay should be monitored within the first couple of weeks after it is baled. Several types of thermometers are available to monitor hay.

Hay Bale Temperature Interpretation

Internal Bale Temperature	Action
150°F	Beginning of danger zone. Chemical reaction occurs and generates heat at a rapid rate. Check internal bale temperatures daily.
160°F	Dangerous. Measure internal bale temperatures every 4 hours and inspect the stack.
175°F	Call the fire department. Wet hay down, remove from barns, or dismantle the stack away from buildings and dry hay.
185°F	Hot spots and smoldering pocket probable. Flames will likely develop when heating hay is exposed to air (oxygen).
212°F	Critical. Temperature rises rapidly beyond this point. Hay will almost certainly ignite.

One method of monitoring internal bale temperature is to drive a hollow probe (made from pipe or rigid electrical conduit) into the center of the bale and then lower a thermometer down the probe. Leave the temperature sensor still for 10 to 15 minutes to ensure an accurate reading. Use spirit-filled thermometers instead of mercury thermometers in case the glass accidentally breaks and contaminates the hay.

Electronic thermometers with remote sensors and a digital readout can also be used. Combination moisture testing/temperature testing sensors are available as well.

Compost thermometers with long stems are ideal. Drive a hollow probe in the hay bale and then insert the stem. Otherwise, the thermometer stem may bend. Regardless of the type of thermometer, it's important to reach the wettest hay, usually located in the center of a stack in the center of a bale. Remember to leave the temperature sensor in the hay for 10 to 15 minutes before taking a reading.

Safety Precautions

Internal bale temperatures can reach 240°F. At this temperature, hay treated with chemical preservatives containing ethoxyquin and BHT (butylated hydroxytoluene) will produce deadly hydrogen cyanide gas.

Do not walk on "hot" hay bales. Internal smoldering will consume internal material and create buried cavities that you may fall through. Instead, walk on planks laid across the bales.

Smoldering hay may ignite immediately when exposed to a fresh supply of air (oxygen). Watch bales carefully for smoke as you move bales from the top of the stack.

HARVESTING

The most effective way to reduce the potential of spontaneous combustion in hay bales is to make sure the cut has dried sufficiently prior to baling. The manner in which and location where you stack hay bales can also prevent overheating.

Weather conditions greatly influence the rate at which hay dries. The ideal curing weather has less than 50 percent relative humidity. This fact may help in setting cutting dates.

To reduce hay compaction and reduce drying time, cut hay after the dew is gone. Also, cutting hay and leaving long stubble will keep the cut hay off the soil surface, allowing more air movement. Cut hay that has been rained on or is slightly wet should be mechanically tedded, or fluffed, to speed up the drying process before baling.

STORAGE

Check newly stacked hay for possible heating, especially hay that has been rained on. It is not unusual for hay to heat to 100°F within the first couple of weeks after it is baled. However, at temperatures above 130°F, the hay should be moved to increase air circulation and cooling.

Cover hay stored outside with tarps. Bales stored in barns should be kept dry. Make sure the roof does not leak and that the bottom bales do not sit in water. Also, newly cut hay should be stored outside and at least 100 feet away from any building.

CONTROLLING HAY FIRES

Early detection of internal hay temperature is the key to saving the entire hay stack, barns, buildings, and adjacent property. Call the fire department immediately if you strongly suspect smoldering hay.

Do not attempt to move the hay around the hot spot because the sudden air exposure can cause this hay to ignite and spread. However, you can apply water to the smoldering hay using a garden hose which may help to keep the flames from spreading too far when the surrounding bales are moved away.

Move all tractors, vehicles, and other flammable materials away from the hay stack.

Hay treated with chemical preservatives containing ethoxyquin and BHT (butylated hydroxytoluene) will produce deadly hydrogen cyanide gas. Be sure to inform firefighters and volunteers if the hay has been treated, since special respiration protection is needed.

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