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Spontaneous Combustion in Hay Stacks

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Each year a few Washington hay producers lose hay and storage facilities to hay fires. What can you do to monitor and prevent hay fires?

Each year in the spring, Washington producers are challenged with small windows of opportunity to bale and store hay at the proper moisture level while avoiding the risk of rain damage. Cut hay must go from approximately 80% moisture to 20% moisture or less in order to be stable in storage as baled hay. The spring season is difficult because of the higher chance of rain and cooler temperatures for drying. Because the highest yield of the season is on the first cut, it takes longer for the hay to dry just due to the bulk. 33% to 40% of the total yield for the year is from the first cut.

Wet hay is more likely to lead to a spontaneous combustion fire than dry hay. If hay is put into a barn or stack when it has more than about 22 percent moisture, not only does the hay lose forage quality, but also it has an increased risk of spontaneous combustion.

High moisture hay stacks can have chemical reactions that build heat. Hay insulates, so the larger the haystack, the less cooling there is to offset the heat.

When the internal temperature of hay rises above 130 degrees Fahrenheit (55 degrees C), a chemical reaction begins to produce flammable gas that can ignite if the temperature goes high enough. Hay fires generally occur within six weeks of baling. All hay baled above 15% moisture will show some elevation in temperature the first couple of weeks in storage. Producers often refer to this elevation in hay temperature following baling as “sweating”. Generally, it peaks at 125 to130 degrees F, within three to seven days, with minimal risk of combustion or forage quality losses. Temperature within a stack then declines to safe levels in the next 15 to 60 days, depending on bale and stack density, ambient temperature and humidity, and rainfall absorbed by the hay.

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To avoid hay fires, small, rectangular bales should not exceed 18 to 22 percent moisture, and large round or rectangular bales should not exceed 16 to 18 percent moisture for safe storage. In addition, you should check your hay regularly. If you detect a slight caramel odor or a distinct musty smell, chances are your hay is heating. At this point, checking the moisture is too late, and you'll need to keep monitoring the hay's temperature.

What do you do if you suspect that your hay is heating?

A simple probe inserted into the haystack can accurately monitor temperature. You can make a probe from a 10-foot piece of pipe or electrical tubing. Sharpen the pipe or screw a pointed dowel to one end, then drill several 1/4-inch diameter holes in the tube just above the dowel. Drive the probe into the hay stack and lower a thermometer on a string into the probe. The thermometer should be left for 10 minutes in several areas of the stack to ensure an accurate reading. You can also measure temperature when taking core samples by placing a thermometer in the core hole.
Watch for the following temperatures:
--150 degrees F (65 degrees C) is the beginning of the danger zone. After this point, check temperature daily.
--160 degrees F (70 degrees C) is dangerous. Measure temperature every four hours and inspect the stack.
--At 175 degrees F (80 degrees C), call the fire department. Meanwhile, wet hay down and remove it from the barn or dismantle the stack away from buildings and other dry hay.
--At 185 degrees (85 degrees C) hot spots and pockets may be expected. Flames will likely develop when heating hay comes in contact with the air.
212 degrees (100 degrees C) is critical. Temperature rises rapidly above this point. Hay will almost certainly ignite.

Take precautions. Pockets may have already burned out under the hay surface. Do not attempt to walk on the hay mass itself.

Hay treated with preservatives may produce hydrogen cyanide gas at 240 degrees F, so extreme caution should be taken when fighting a hay fire if hay has been treated with such preservatives. Hay treated with preservatives containing ethoxyquin and BHT (butylated hydroxytoluene) produce hydrogen cyanide gas at around 240 degrees (115 degrees C). This gas is deadly. Additives containing primarily propionic acid to not produce hydrogen cyanide during a fire.

In the past, farmers sprinkled salt on wet hay as it was stacked to prevent spoilage, but salt does not prevent spontaneous combustion. Dry ice, liquid nitrogen or carbon dioxide gas pumped into the hay can prevent combustion by eliminating the oxygen from the hay mass. Hay fires from spontaneous combustion occur infrequently in the arid western U.S., but can be a hazard for new hay or old stacks. Good storage practices will avoid spontaneous combustion and ensure higher quality hay.

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