Damp Hay a Fire Risk

Now that floodwaters have receded, it is time to monitor your damp bales for the risk of spontaneous combustion.

Story & photos by ***Ed Haag***

►Hot, flood-damaged bales should be moved out of the barn.

Feeding & Feedstuffs

Water is supposed to put out fires, not start them, but in situations where hay bales have been exposed to floodwaters or excessive rains, starting a fire is precisely what water will do.

"Hay in a bale is supposed to be a dry, stable product," says Steve Fransen, Washington State University (WSU) forage specialist. "When it gets wet, that is when it becomes unstable."

Fransen is talking about the microbial action that takes place when hay is dampened.

"These bugs produce heat, and if the heat is produced in the center of a pile of bales, it has no way to dissipate," he says. "That is when you get spontaneous combustion, and your barn burns down."

In 2007, WSU's Skagit Valley fell victim to extensive flooding. Fransen was called in by the state's department of agriculture to provide guidance to local dairy and beef operators on how to deal with thousands of tons of flood-damaged hay. His advice to the flood victims in the Midwest is to pay attention to your water-damaged hay.

"For people that have been flooded out, this is one more thing they have to contend with," he says. "But this doesn't make it any less important. The risk to life and property is very real if you choose to ignore the situation."

While the flooding this year is the most visible cause of damp bales, it is certainly not the only cause, says John Hall, University of Idaho Extension beef specialist. "In some areas of the country we have had so much excessive moisture that people, in their desire to get hay up any chance they get, might rush things and put those bales up too wet. That will also increase the chances of hay fires."

Fire prevention begins in the field

For Hall, preventing hay fires begins in the field. During normal production years, ranchers in most parts of the country should have little trouble bringing their hay's moisture concentration down to 20% or less for small rectangular bales. Large rectangular or round bales should be baled at 18% moisture or less.

"The trouble comes in wet years when there is no letup on the rain, and it is really hard to get the moisture down in the field," he says. "That is when we really need to know what the moisture content is in the hay we bale."

To avoid any error, Hall recommends that a moisture probe be used to determine when the hay is ready to bale.

"For what hay is worth today, the cost of a hay moisture probe ($200-$300) is well worth

the investment," Hall says. "Then you know for sure when it is dry enough to bale."

He notes that random testing with the probe will probably provide a general moisture reading, but there are always areas in a field where hay dries more slowly. This can prove to be a problem, especially since the industry has shifted from small to large bales.

"In the old days, when you put up the small square bales, if you hit a wet spot in the field you would immediately know when you put them on the loader," Hall says. "They were really heavy. You knew they were wet, so you kicked them off to the side and let them dry some more by themselves."

In a world populated by large balers, that option is no longer a possibility, Hall says. "What would have been five or six square bales out of a field is now in the middle of a large round bale."

Other options

A bulletin on preventing bale fires prepared by faculty at Virginia Tech when Hall was serving as its Extension beef specialist suggests that some specialized hay equipment can help reduce hay moisture concentration by increasing crop-drying rates. Hay conditioners macerate the stems to promote moisture evaporation and shorten the drying time. Hay rakes turn and fluff windrows in order to expose more of the cut hay to the sun.

One way a producer can put up higher-moisture hay — allowing an increase in the total moisture content in a bale from 18% up to 30% — is applying propionic acid, a bacteria inhibitor, to the hay as it is fed into the baling chamber.

While propionic acid is an effective hay preservative, reducing the likelihood of bacterial action or the development of mold, it is not without its shortcomings. With a price tag of $1,000-$1,500 to retrofit a baler with an applicator and with the corrosive nature of the acid itself, some ranchers might be tempted to seek out a more cost-effective solution.

For those who have the misfortune of trying to make hay without the benefit of sun, Hall has the following suggestion.

"Some of these guys in these real wet areas who aren't getting any relief might think about putting their round bales into silage bags," he says. "Sure it is an expensive option ($12-$24 per ton on a dry-matter basis), but if you can't get your moisture much lower than 50%, it is probably your best one."

Hall notes that ensilage machines for round bales are available for rent in most parts of the country. Hiring a custom silage bagger to do the job might be just as cost-effective.

Monitor, monitor and monitor some more

The individual who has to deal with previously dry bales that are flood-damaged and wet faces the same basic dilemma as the person who baled his hay when the moisture level was too high. In both cases, bales are at risk of a fire due to excessive microbial action that in turn raises the temperature inside the bale to the point of spontaneous combustion.

While hay that is put up wet will most likely show signs of heating within six weeks, bales that have been flood-damaged are less predictable.

"It is going to take some time for the microbial activity to start the process inside the bale," Fransen says. "Just because there hasn't been any heat damage or heating as soon as the water goes down, they are certainly not out of the danger zone."

Fransen is emphatic about establishing a rigorous monitoring plan that includes watching for steam rising from bale surfaces and condensing on the roof and eaves of the barn. Other indicators may include the growth of mold on those surfaces and an acrid, tobacco odor emanating from the bales.

If the hay is not stored in an enclosure, determining the risk of fire is less obvious.

"The outside of the stack might be nice and cool because you have the breezes outdoors that are taking the heat away from the surface," he says. "You have to test the inside of the stack to see where all the action is."

Whether the hay is stored inside an enclosure or outside, Fransen recommends checking the temperature inside a stack to make sure heat is not accumulating at its core. With hay that has been put up on the damp side, he recommends a monitoring period of twice a day for a minimum of six weeks. For flood-damaged hay, it should be twice a day for a period of time for the bales to reach a peak temperature and indicate a definitive downward reduction or ability to maintain temperature stability for no less than two months under drying conditions.

To test bales individually, insert a heat probe in the core at the end of a round bale and in the side of a large square bale. If a long shaft temperature probe is not available, a crowbar can be used instead.

To assess the core temperatures with a crowbar, insert it into the bale as far as possible and leave it for two hours. The crowbar can be used in a similar fashion to monitor stacked hay by pushing it between the bales in a stack.

Once removed, if the bar is cool or neutral to the touch it is likely that heating has yet to occur. A bar that can only be held for a short time indicates that the internal temperature of the bale is approaching 130° F, while a bar that is too hot to hold is a warning that the core temperature of the bale is 140° or higher.

Fig. 1: Homemade hay temperature probe with thermometer

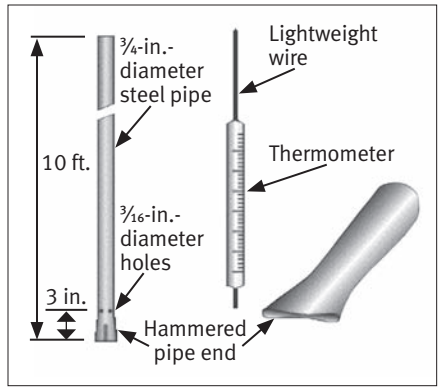
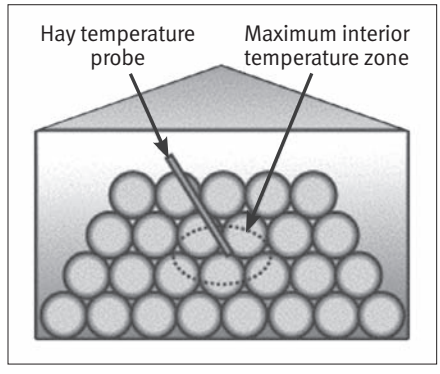


Fig. 2: Proper procedure for monitoring hay temperatures

Fig. 3: Proper location for inserting temperature probe



Source: Line-drawn illustration and temperature table reprinted with the permission of Virginia Tech from Virginia Tech Publication No. 442-105, "Hay Fire Prevention and Control," by Susan Gay, Extension engineer, Department of Biological Systems Engineering; Robert Grisso, Extension engineer, Department of Biological Systems Engineering; Ray Smith, Extension forage specialist, Department of Crop and Soil Environmental Sciences; and Jerry Swisher Jr., senior Extension agent (Retired), dairy science, Augusta County.

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"Once the bale temperature reaches about 150° Fahrenheit, the hay is on a one-way street and going in the wrong direction," Fransen says. "Above that temperature, more heat-resistant bacteria start chemical changes that rapidly increase temperatures to the point of spontaneous combustion. When the bale temperature gets to 150° to 160° it's time to take immediate action and call the local fire department."

For monitoring larger stacks, the agricultural engineers at Virginia Tech suggest using a 10-foot (ft.) section of ¾-inch (in.)-diameter iron pipe with eight 3/16-in.-diameter holes drilled about 3 in. from an end that has been crimped. The crimped end is then driven into the center of a stack. A thermometer attached to a wire is then lowered through the open end of the pipe to the bottom of the pipe where it remains for 10-15 minutes.

One very important warning from both the authors of the Virginia Tech bulletin and Fransen involves walking on top of stacked hay that could be combusting inside. While the easiest way to take the core temperature of a stack is from the top, extreme caution should be exercised.

As Fransen mentioned earlier, when the temperature reaches around 150°, it is time to clear the animals and equipment out of the building in which the hay is being stored and call the fire department. While waiting for their arrival, prepare two locations outside — one to place the good hay in and one for the hot or burning bales.

Once help has arrived, carefully remove the bales from the structure, keeping in mind that the exposure to air could initiate combustion. Hot bales should be placed in a location where there is good airflow, and large square bales will probably have to be broken apart to reverse the heating process.

Before feeding, carefully inspect the flood-damaged hay for contamination. Rather than risk sickening your livestock, compost any suspect hay and reapply it on your fields. AJ

Table 1: Temperature interpretations for hay stacks

Temperature, °F	Interpretation
<130°	Continue monitoring temperature twice a day.
130°-140°	Temperature may go up or down. Recheck in a few hours.
150°	Temperature will most likely continue to climb. Move the hay to provide air circulation and cooling. Monitor temperature every two hours.
>175°	Fire is imminent or present. Call the fire department immediately. Continue probing and monitoring the temperature.

Source: Virginia Tech Publication No. 442-105, "Hay Fire Prevention and Control," by Susan Gay, Extension engineer, Department of Biological Systems Engineering; Robert Grisso, Extension engineer, Department of Biological Systems Engineering; Ray Smith, Extension forage specialist, Department of Crop and Soil Environmental Sciences; and Jerry Swisher Jr., senior Extension agent (Retired), dairy science, Augusta County.