PRESERVATIVES FOR THE PRODUCTION OF QUALITY BALED HAY

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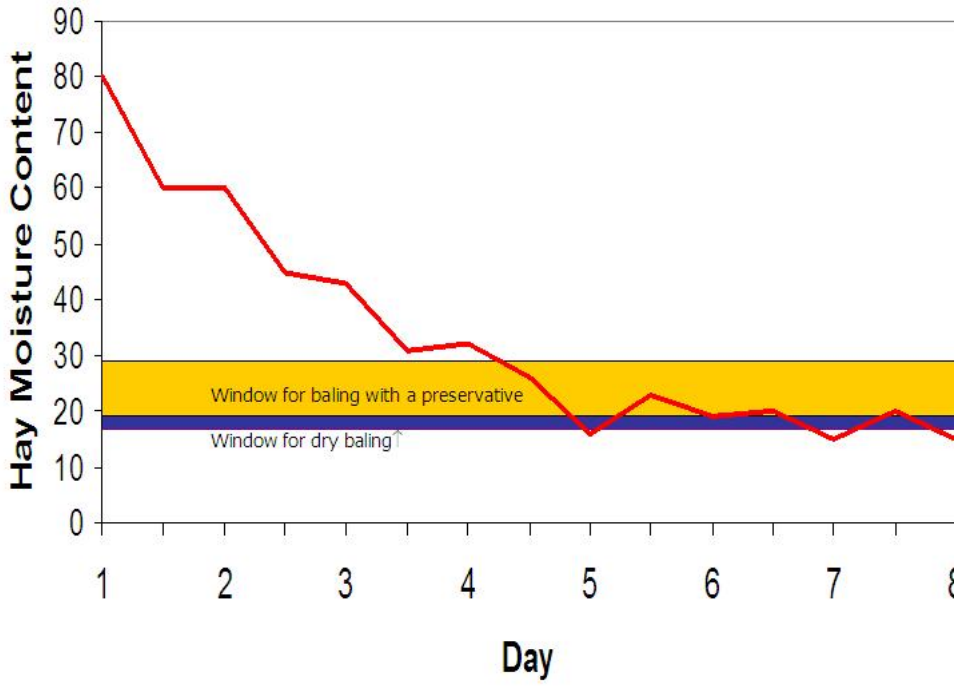
Baling hay at the correct moisture. 13% to 17% , is not always possible and over one-half of baled hay produced is damaged by not hitting this level at baling. This damage is due to baling too wet or baling too dry. Hay harvested above 18% actual moisture will heat, mold, and loose feed value and palatability. Hay harvested below 14% moisture will be brittle, have leave shatter and high dry mater loss. The window for optimum baling is indeed, very narrow and hard to hit with the forces of the environment dictating the drying rate of the cut hay.

This graph illustrates the expansion of the operating window for baling that a good preservative will offer:



A good preservative program actually triples the number of hours a baler can operate, by expanding the level of baling from a top end of 17% to at top end of 30%. Hay produced in the 17% to 30% range will yield better, feed better and get up sooner due to the lower number of drying hours required. Since producers of hay are fearful of the consequences of baling too wet, they typically error on

the side of baling too dry. By having a preservative application system on a baler, preservatives actually slide the operating window for baling up several points, by covering the top end of the range of moistures in a field

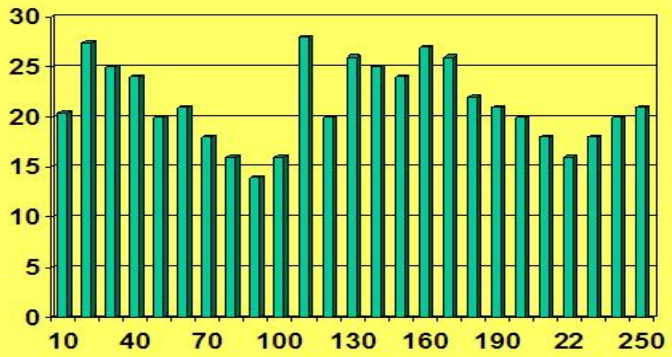
In the production of alfalfa, hay baled at 22% moisture will yield 15% more dry matter and test 20 points higher in relative feed value that hay baled at 14%. The picture below shows why: Leaf content.

So what is a good preservative program? It consists of two things:

- ✓ **A HIGH QUALITY PRESERVATIVE PRODUCT**
- ✓ **AN ACCURATE APPLICATION SYSTEM**

Producers of hay are comfortable baling fields that are completely cured. When a field of hay that is not completely cured is approached, it will have a variation of moisture content that are wider than those a producer has been used to. Take a look of a windrow that is in the 15% to 30% moisture range. Two hundred and fifty feet of a windrow in a New Mexico hay field, was tested for moisture content.

Windrow moistures taken every 10 feet-2nd cutting alfalfa, Artesia, New Mexico



In this typical example, the low moisture section of the windrow is below 18%, not requiring any preservative to prevent heating of hay in the bale. The high moisture is above 25%, requiring a high level of an effective preservative product to keep that part of the bale from heating. Windrow moisture variation is the main factor that makes baling fields that are not completely cured, a major challenge.

SELECTING THE RIGHT PRODUCT:

Since filed that are not completely cured will have spots that are over 25% moisture, it is important to use a product that will effectively preserve hay that wet. There are three types of products on the market:

1. Crop inoculants.
2. Straight acid.
3. Buffered acid.

Crop inoculants, dry or water soluble, are live bacterial cultures that can out compete with spoilage organisms to keep hay from heating. If the environment is correct, they will grow and prevent naturally occurring bacteria's to grow and heat-up the hay. And conditions have to be right: controlled moisture between 18% and 22%, a low presence of naturally occurring spoilage organisms, and, limited air availability like one would have in a tightly formed bale in a close stack. Because of the difficulty in getting such a tight range of moistures, inoculants have proven unreliable and are not widely used on baled hay.

Straight acid works fine between 17% and 30% moisture. However, with a pH of 1.0, they are extremely corrosive and difficult to use. They will take the paint off of a baler in a matter of minutes and cause severe burns to operators who come into contact with them.

Most of the usage of hay preservatives is with buffered acid. These acids are processed raising the pH from 1.0 to around 6.0, about the same as rainwater.

These acids will not corrode equipment, and if properly buffered, they are as effective as straight acid. The most effective acid for the money, in controlling mold, is propionic acid. It is an organic acid, naturally occurring in the rumen, and safe for consumption by all types of livestock, including horse, dairy and beef animals. Products containing buffered propionic acid typically list the level of propionic acid on the label, but this listing can be the level of acid before the reaction, the theoretical level after the reaction, or a result on a chemical test that can be done severl different ways. Recently the US Environmental Protection Agency has made an attempt to standardize labeling, but enforcement has been spotty, so it is best to concentrate on the manufacturer's label of required application when deciding how much product to use. A good label will list higher levels of application for large square bales than for conventional or round bales. It will also list higher rates of application for hay with stem moisture as compared to hay that has dew moisture only. The label of a leading buffered propionic label looks like this:

Stem moisture:	Conventional square and large round balers
large square balers	
16% to 22%	4 pounds per ton
6 pounds per ton	
23% to 25%	8 pounds per ton
10 pounds per ton	
26% to 39%	16 pounds per ton
do not bale	
dew moisture only:	
16% to 22%	3 pounds per ton
4 pounds per ton	
23% to 25%	6 pounds per ton
8 pounds per ton	
26% to 30%	12 pounds per ton
16 pounds per ton	

Rates of application really increase with moisture gain. Therefore, it is extremely ctirical to know what the moisture of the hay is, and apply the amount of product to cover that moisture.

SELECTING THE RIGHT APPLICATOR:

As seen in the typical application rate chart above, preservatives are applied at less than 1% of the crop being treated. It is important to cover all the hay being baled, evenly to prevent hot spots that can result from lack of coverage. Spray nozzles need to be located in the intake throat of the baler, as the hay comes off the pickup and is grabbed by the stuffer arms. The best coverage comes from using a fine spray at medium pressures, (20 to 60 psi), with the spray pattern covering the entire width of the intake.

The most important job for an applicator is the calibration it does based on the moisture of the hay. One method of application, is to make several bales, stop and take moisture tests with an electronic moisture tester. Keeping in mind the variation in the windrow will be at least 5 to 10 points in moisture, it is not practical to use more accurate testing methods like drying with a microwave, or using a Koster tester. By the time multiple tests were run using heat test, the hay moisture of the field would have changed. Electronic testers can give a good estimate of moisture if multiple readings are taken. In deciding how to set the applicator, follow these guidelines:

Bale Type	Number of Test Bales	Samples per Bale	An Example of the Readings Seen	Where to Set Application Rate
Conventional Square	5	3	20-16-19-22-28-20-17-21-20-16-24-21-14-22-23	24%
Large Round	2	8	23-21-29-26-22-28-31-26-24-23-21-18-24-26-21-27	28%
Large Square	2	8	16-14-18-13-15-12-16-17-15-18-14-17-12-20-16-17	18%

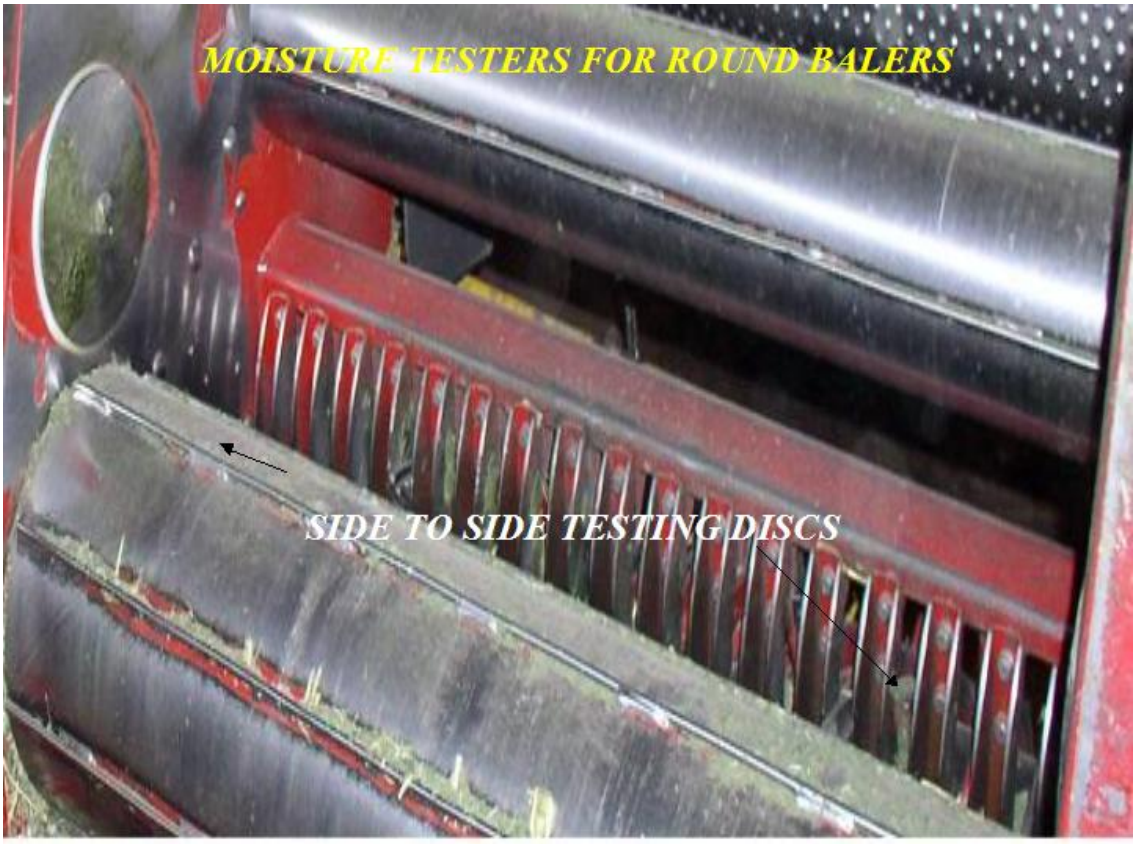
The applicator can be set for the second highest reading. The applicator should have an easy-to-follow method of rate adjustment, and it should include multiple sets of spray tips since application rates have a four-fold increase from 16% moisture to 30% moisture. A single set of spray tips will only allow for a doubling of rate, so select the proper tips to cover the highest anticipated rate after doing the initial moisture test. And, stop and check moistures often. Keep in mind that different parts of the field could have different drying rates. And keep in mind that moisture can change quickly during the day, so check the hay frequently.

Using a hand tester to monitor moisture requires a lot of testing. It also leads to the over application in much of the hay being baled. The application rate has to be set to cover the wetter part of the hay being baled. A recent development in application equipment has provided a major improvement in the efficiency of hay preservative application. Harvest Tec, a Wisconsin-based manufacturer, has developed accurate on-board moisture sensing devices for all balers. The first version of these has actually been around for five years, fitted on over 3,000 large square balers around the world. Two star wheels are mounted on top of the bale chute, right behind the knotters. One wheel is positive, and one negative, using the conductivity of the hay to sense moisture. They are located on the outside edge of the bale, so sensing is across the entire package,

giving an accurate reading of the entire windrow. These wheels sense the hay 28 times per seconds, and an average of 96 readings is updated to the applicators control system every 3 seconds.

The 2 star wheel sensor is also used on conventional square bales. Because these wheels take so many readings and because they sense across a large distance, they provide accuracy within several points of a reading that would be taken using a coring tools and an oven.

The wheels do not fit on round balers. Instead, 2 eight-inch discs are mounts to the sidewall, inside the chamber and just above the starter role. Again, these discs use electrical conductivity to sense all the way across the bale. They read 28 times per second and update readings every three seconds, based on the average of 96 reading. Readings from these discs will profile accuracy with several points of a core and oven reading.



These accurate moisture-testing devices are the heart of Harvest Tec's automatic application systems. The systems are set to automatically turn the application on at 16% for large square bales, and 18% for conventional and large round bales. Automatic systems are not running all of the time. When they are on, they are adjusting application rate to moisture content of the hay, making an adjustment every three seconds. Application is matched to the condition of the hay, and therefore, the automatic system utilizes product more efficiently than a standard system, and, at the same time makes sure that all the hay is treated with enough product to prevent heating. It is the system to use to do the job right.