Angus breeders and researchers alike are finding inside storage of big round bales can be cost-effective, and treating bales with anhydrous ammonia has possibilities for improving low-quality hay.

Big Bales Can Be Big Problems If Not Handled

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The popularity of packaging hay in big round bales has snowballed since their introduction in 1970. Since then, cattle producers have been searching for ways to improve the quality of baled forages and increase the efficiency of using these bales in their operations.

This story will investigate one of the newest methods of improving feed quality of big bales, and different storage techniques available today.

Ammoniation

One of the newest ways of improving low-quality forage in big round bales is by ammoniation.

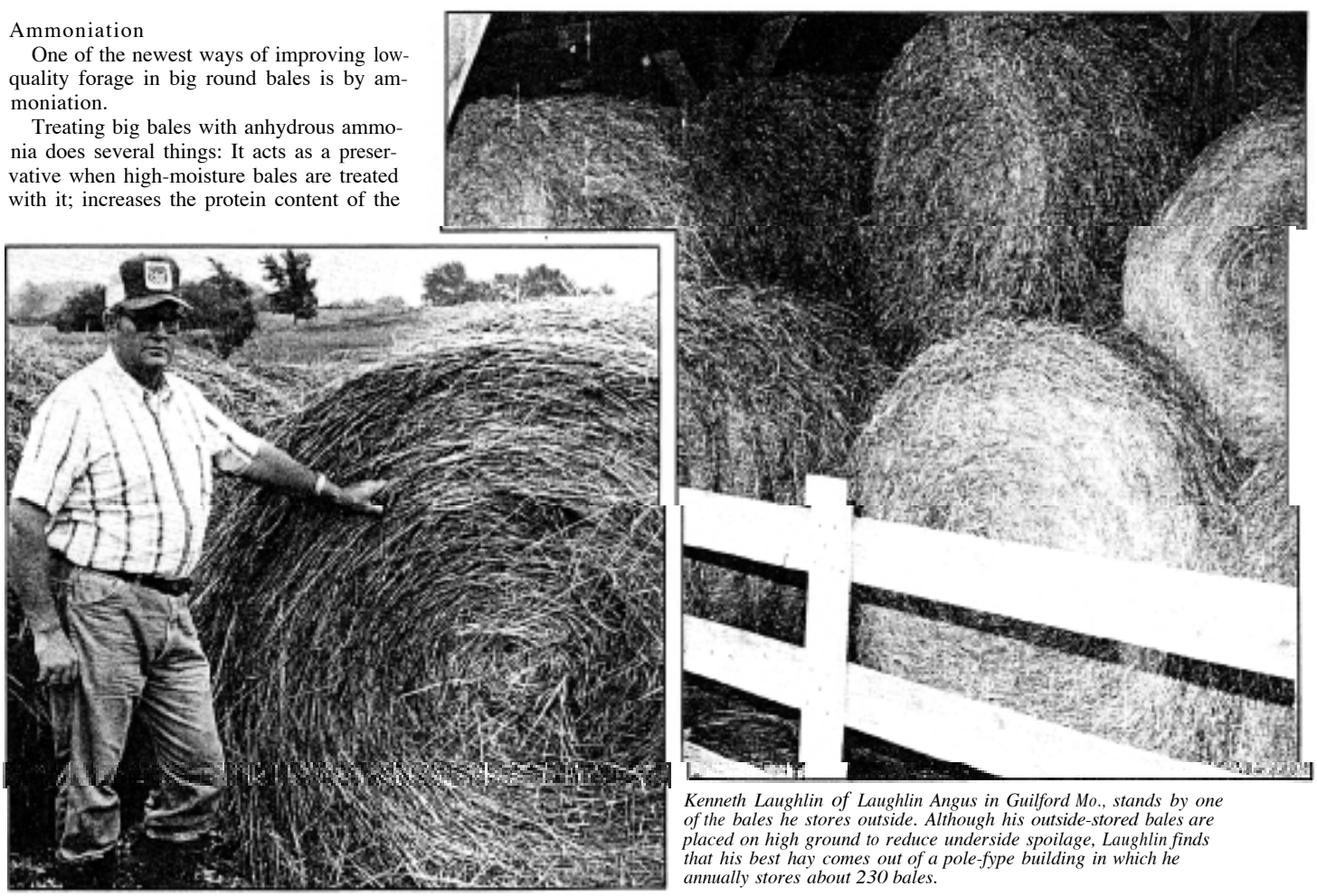
Treating big bales with anhydrous ammonia does several things: It acts as a preservative when high-moisture bales are treated with it; increases the protein content of the forage; increases the digestibility of the product; and dramatically improves the palatability and consumption of the hay. As a result, animal performance is improved.

Researchers at Purdue University, the University of Nebraska, and the University of Missouri-Columbia (UMC), have done extensive work ammoniating big round bales of low quality hay and crop residues.

Kern Hendrix, extension beef specialist at Purdue, says the initial purpose of their research was to investigate preservative properties of anhydrous ammonia on big bales of high-moisture hay.

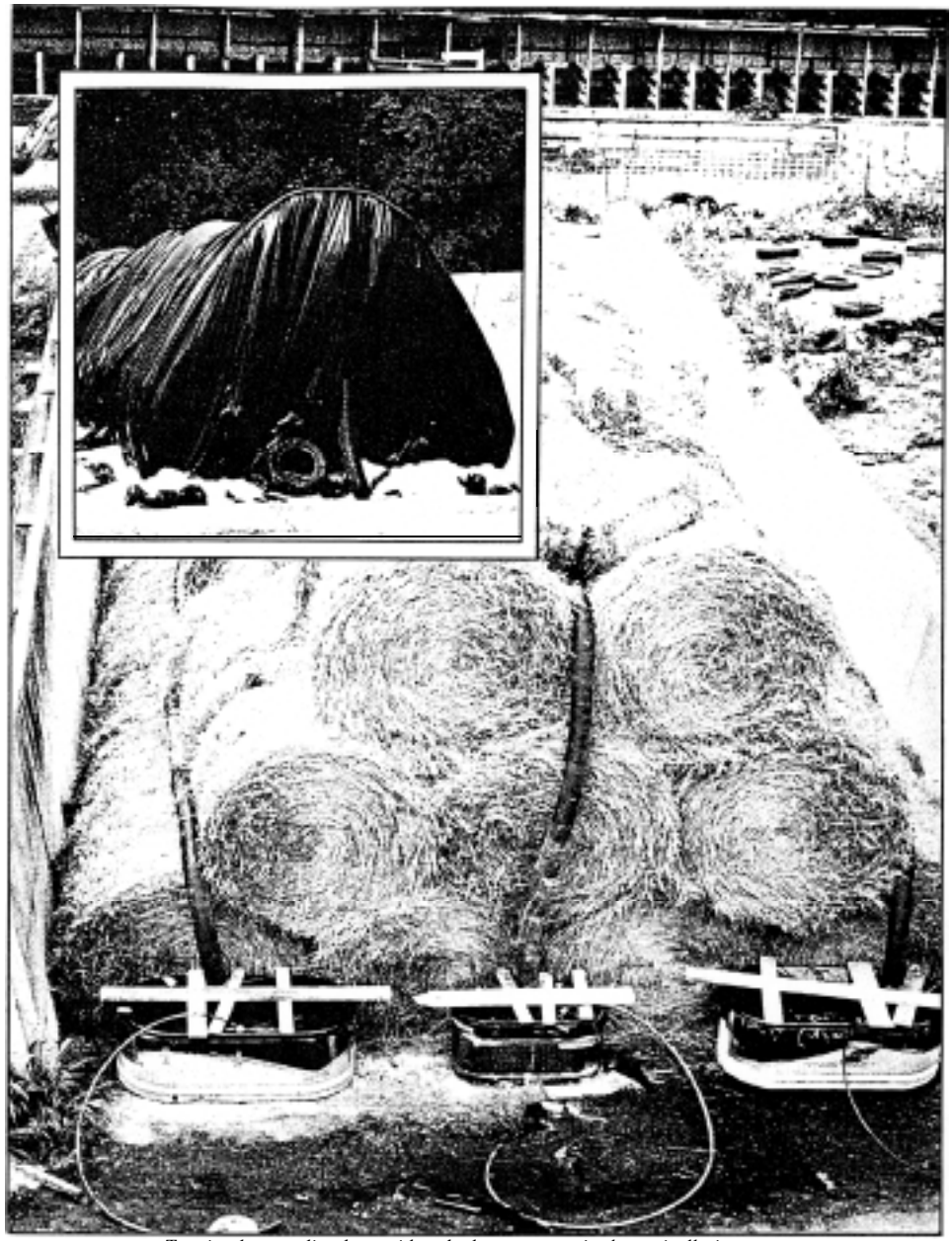
They found that ammonia, added at the rate of one percent of the dry matter weight of the bale, stopped the formation of mold and prevented spoilage in bales containing up to 25 to 30 percent moisture.

In addition to the preservative qualities, researchers also found the anhydrous increased levels of crude protein and total di-



Kenneth Laughlin of Laughlin Angus in Guilford Mo., stands by one of the bales he stores outside. Although his outside-stored bales are placed on high ground to reduce underside spoilage, Laughlin finds that his best hay comes out of a pole-fype building in which he annually stores about 230 bales.

Properly



Treating low-quality hay with anhydrous ammonia dramatically improves digestibility palatabilty and nutrient content. One method of ammoniation, illustrated here, involves running anhydrous through tubes in stacked hay. Before anhydrous can be added to the bales, the stacks must be covered with plastic. -Photos by Kern Hendrix, Purdue University

gestible nutrients, and improved the palatability of the hay. Higher levels of ammonia not only acted as a preservative, but also increased feed values.

Cattle Eat More Ammoniated Feed

Hendrix says when ammonia, in the amount of 2.5 to 3.0 percent of the dry weight of the forage was added to the bales, crude protein was increased six to eight percentage units. Total digestible nutrients were increased by seven to nine percent. Due to the increase in crude protein levels, high TDN and greater palatability, cattle on test consumed 15 to 20 percent more of the ammoniated feed than the non-ammoniated feed. Daily gains for growing beef calves fed treated orchard grass was one-half to one pound greater than calves fed untreated hay.

John Patterson, assistant professor of beef cattle nutrition at UMC, says that in research conducted in Missouri, low-quality tall fescue hay baled in late August and treated with anhydrous showed an increase in digestibility of 10 percent. The average daily gain of those cattle fed treated hay was 15 percent higher than the daily gain of cattle fed untreated hay, due to increased consumption of the treated hay.

"In a 70-day feeding period, we found that the 16-head test given the treated hay ate 18 bales, compared to the 16-head control group which ate 14 bales of the untreated hay," says Patterson.

Ammonia works its wonders by acting as a sort of predigestive system before cattle even eat the forage.

"The ammonia does a couple of things. It starts breaking down the hemicellulose in the cell walls of the forage, causing the forage to actually start breaking down before the animal eats it," explains Patterson. He also thinks ammonia causes plant fibers to swell resulting in more surface area with which rumen bacteria react.

Hendrix says, "As the forage matures, the fiber becomes less digestible because of lignin formation. We have hypothesized that ammonia reacts with the fiber and breaks down lignin so the fiber is more digestible."

How It's Done

Several methods for treating big bales with ammonia are available to cattle producers. Probably the easiest and most economical way for most is to combine the two methods used in research at Purdue and the University of Nebraska.

A treatment site for each stack must first be prepared. If a concrete slab of at least 25 x 100 ft. is available, use it. If not, select a spot on top of a hill with good drainage in all directions. Using a tractor-mounted blade, prepare the treatment site by removing approximately three inches of dirt. Pile this dirt around the perimeter, because it will be used later to seal the edges of the plastic.

After the site is ready, stack the bales. There are many ways in which this can be done. Just remember not to stack more bales than can be covered by a 40 x 100 ft. sheet of six mil plastic. Purdue suggests placing three rows of 11 bales each on the bottom, topped by two rows of 10 bales each. On top of these should be placed one row of nine bales, resulting in a pyramid-shaped stack of 62 bales. Researchers at Nebraska recommend spacing the bales several inches apart so the ammonia can penetrate all the bales.

Before the stack is covered and the plastic sealed, two one-inch plastic pipes of about 25 ft. in length must be inserted between the bales into the center of the stack. The pipes should be inserted approximately 20 ft. from each end of the stack.

The stack is then ready to be covered and sealed. A wind-free day is necessary and the

job may require as many as six people to handle the plastic and keep it from blowing. After the stack is covered completely, seal the plastic by securing the edges with enough dirt (removed from the site earlier) or lime to make sure it will not blow off in high winds. Sealing the plastic also assures no ammonia will escape.

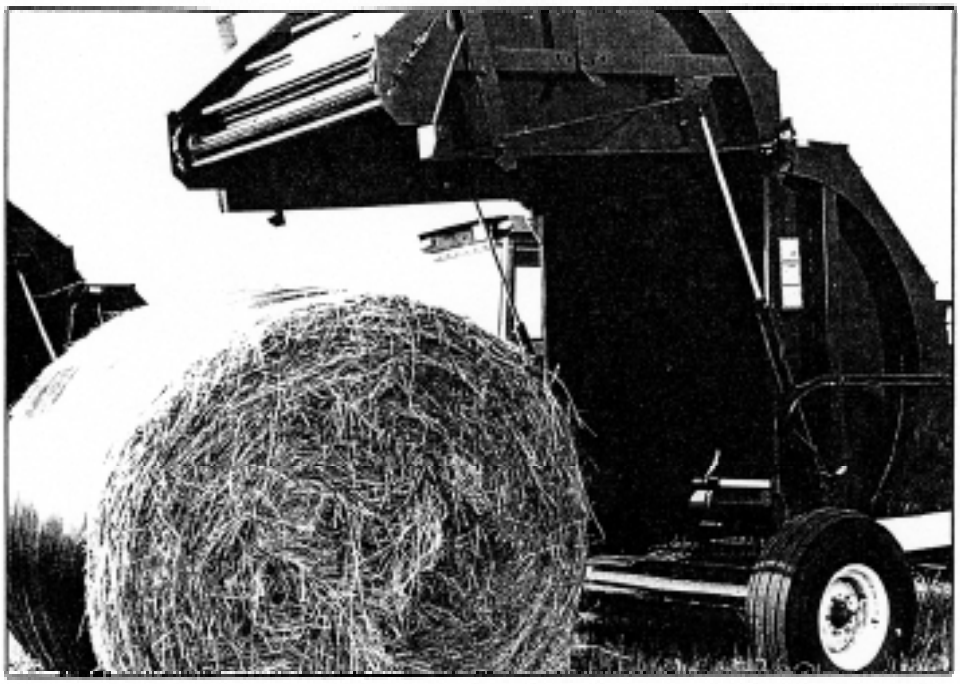
Administer Ammonia Through A Regulator

When the stack is completely covered and sealed, ammonia should be administered through a regulator into the plastic pipes and bales. The current recommended rate of three percent of dry matter is a good guideline. The following calculation can be used to arrive at the proper amount of ammonia (NH3) needed for your operation.

(Average Bale Weight) (Percent Dry Matter) (Number of Bales) (.03) = Pounds of NH3.

Example: 900-lb. bales, 80 percent dry matter, 65 bales. (900) (.80) (65) (.03) = 1,404 lb. NH3.

Hendrix recommends the ammonia be added at a rate no greater than 600 lb. per hour to prevent excessive vaporization of the anhydrous and ballooning of the plastic. For greater accuracy and safety, he recommends using a regulator that meters in pounds of ammonia. When treating the bales, use the same cares and precautions as used in normal field application of anhydrous.



This M&W 1800 baler wraps bates with l.5 mil plastic before leaving thechamber. M&W recommends bates be wrapped at least three times for the plasticsleeve to be effective.

If the plastic should happen to rip or tear, it must be fixed immediately to keep ammonia leakage to a minimum. Duct tape works well for patching small holes. A producer using this ammoniation process should check the stack periodically for holes in the plastic.

After the anhydrous is introduced into the stack, the bales must remain covered for a number of days to allow the NH3 to react

and bond with the forage being treated. How long the bales have to remain covered depends directly on the outside air temperature.

"The reaction of the anhydrous to the bales is very temperature dependent. When it's hot, the reaction really goes," explains Patterson. "If you are adding anhydrous in July or August, the reaction will probably take a week to 10 days. If you are treating bales in the middle of January, it will probably take 25 to 30 days for the reaction to take place. The hotter it is, the faster the reaction."

Ammoniation Costs $10 to $12 Per Ton

The economics of ammoniating big bale forage depends greatly on the availability and costs of alternative feed sources. Since ammoniating big round bales costs between $10 and $12 per ton, treating these bales is not always the most cost-effective feed alternative available to producers.

Patterson adds, "Ammoniating bales fits into times when corn prices are high enough to make it economical. Given today's corn prices, it probably wouldn't be economical."

Hendrix maintains that, "Only lower quality forages justify ammoniation. When you normally feed low-quality untreated forages, you have to make up for the lower nutritional value of the forage by feeding costly grain and protein supplements. When you feed treated hay you greatly reduce or eliminate feeding these products so the cost of ammonia treatment is justified."

Both researchers emphasize taking great care in handling the plastic to reduce the risk of rips and tears. Plastic constitutes a large share of the ammoniation process expense, so using it two or three times after the initial use will greatly reduce the costs of the operation.

Select Proper Storage Method

Ammoniation can be useful as an emergency technique for preserving high-moisture hay and increasing the feed value of low-quality hay and crop residue. However, the key to efficient use of big bales is storing them in the proper manner.

In addition to the preservative qualities, researchers also found anhydrous increased the levels of crude protein and total digestible nutrients, and improved the palatability of the hay.

There are about as many ways of storing bales available to cattle producers today as there are big round balers on the market. Cattle producers must sort through all options available and then decide on the most cost-effective storage method for their individual operations.

Many people store bales outside on the ground, with no protection from the elements. Some place bales on gravel to allow moisture drainage, thus reducing the amount of underside spoilage.

Still others wrap bales individually with plastic, or stacks of bales with tarps or plastic, to try to reduce weathering losses.

Ammonia works its wonders by acting as a sort of pre-digestive system before the cattle even eat the forage.

But a growing number of researchers and cattle producers alike are discovering, in the long run, the most cost-effective method of storage is putting the bales inside a barn or pole building.

Bill Hires, associate professor of agricultural engineering at UMC, says "The only thing I'm enthusiastic about is barn storage. Everything else is more time consuming and more expensive in the long run."

Each storage method has certain advantages and disadvantages. Angus breeders should evaluate their current methods of storage, and if economic advantages do not outweigh disadvantages, a change should be considered.

Plastic Sleeves May Have Potential

Purdue is currently in the second year of a two-year project; their work involves a

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comparison .of inside and outside storage. Researchers there are studying three test groups: 1) bales stored inside in a pole-type building; 2) bales stored outside wrapped individually with plastic sleeves currently on the market; 3) bales stored outside with no protection.

Although it is too early to make any recommendations to cattle producers, Hendrix thinks the plastic sleeve might have some potential as a method for storing big round bales.

Hendrix says the sleeve prevents weather damage except to the uncovered ends of the bales. The main concern of researchers at Purdue is that sun shining on the plastic may cause hay to heat substantially right after harvest, when it still has a relatively high moisture content.

Hires calls this reaction a greenhouse effect. He says the moisture in a high moisture bale goes to the bottom, where it molds and rots the lower part of it bale. The odor then spreads through the entire bale and decreases its value.

Hendrix elaborates: "Any time the temperature of a bale gets much above 120 degrees and the moisture levels are in the 23 to 25 percent range, the proteins and carbohydrates bind together, causing a caramelizing effect. We (Purdue) think the sleeve aggravates this effect because it doesn't allow the moisture to escape."

Stan Bell, research specialist at the University of Missouri Southwest Center in Mt. Vernon, savs that if bales are aoina to be stored outside, they should be stacked in pyramid form and covered with tarps or plastic.

Uncovered bales left outside can incur dry matter losses of up to 40 percent, and nutritive losses of up to 30 percent. This is only part of the problem of storing uncovered bales outside.

'I think a loss that most people don't consider when feeding weathered hay is the loss in animal performance," Bell adds.

Researchers at the Southwest Center found that animals fed uncovered hay consumed about 3.5 lb. less dry matter and gained 0.2 lb. less per day than animals fed covered bales.

It is hard to put an exact dollar amount on the economic losses in big bales due to weathering. However, Bell says, "A very conservative figure would be a loss of $10 per bale. When you take the lower animal performance into consideration, you're really talking about a loss of $15 per bale."

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Bell feels, as do several other researchers, storing big round bales inside is the most cost-effective method of storage available to cattle producers today.

B.D. Nelson and L.R. Verma conducted a study evaluating quality changes and storage losses with large round bales of ryegrass and alfalfa in southeastern Louisiana.

Both ryegrass and alfalfa big round bales showed that protection for weathering and storage off the ground are essential in avoiding excessive dry matter and nutritive losses.

Shrinkage and storage losses of ryegrass hay after seven months' storage.

	Percent Losses			
Storage Method	Handling	Dry Matter	Refusal	Total
Gravel	1.2	31.2	16.8	49.8
Ground	15.0	27.6	22.6	65.2
Rack	5.2	26.0	6.6	37.9
Rack w/cover	0.0	12.3	1.5	13.8
Tires	2.0	35.4	6.3	43.0
Barn	0.0	2.3	1.2	3.5

A growing number of researchers and cattle producers alike are discovering, in the long run, the most cost-effective method of storage is putting the bales inside a barn or pole building.

Inside Storage Is Cost-Effective

"One-third of the hay in a big round bale is in the outer six inches of the bale," he says. "I don't think any producer can afford to lose a third of his hay. So in the long run, I think an open-sided shed is the best way to store these bales."

Several Angus breeders agree that although storing big round bales outside may be the cheapest storage method available, it is not necessarily the most cost-effective.

Dr. I.C. Keeney, owner of Keenview Angus Farms, Houston, M O., has three 40 x 100 ft. buildings on his farm, in which he stores his entire alfalfa hay crop of 600 bales.

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Keeney is very happy with the high-quality hay he gets from storing big round bales inside. Because of improved quality and reduced spoilage, Keeney says if he didn't already have buildings for storing big bales, he would build them.

Kenneth Laughlin, owner of Laughlin Angus in Guilford, M O., is also satisfied with big round bales stored inside.

'Sometimes there is a little mold on the bottoms of bales on the floor, but the other bales are really good. We've taken bales out of there that are just as green as the day we put them in," Laughlin says.

"If producers are going to be serious about feeding big round bales, they are just going to have to bite the bullet and put up a building."

He also believes an open-sided building can pay for itself when all the waste with bales stored outside is considered.

The Bottom Line

The bottom line seems to be that if you're serious about feeding big round bales, and feed enough of them, storing them inside is probably the most cost-effective way to improve feeding efficiency.

Bell says, "If you've got the time to feed square bales, I would feed them. If your operation is big enough and you don't have time to deal with the inconveniences of square bales, you can afford to feed big round bales. You can also afford to put up a building for storage."

Ron Morrow, associate professor of animal science at UMC, simply says, "If producers are going to be serious about feeding big round bales, they are just going to have to bite the bullet and put up a building:"

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