

*Cooperative Extension System*

# Cattle Producer's Library

Cow-Calf Section

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## One Method of Ammoniated Straw for Beef Cattle<sup>1</sup>

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Managers faced with the lack of pasture and high-priced feed during drought conditions look for alternatives to their usual methods of wintering beef cattle. Those who have wheat or barley straw may find that ammoniation could solve their winter feeding problems.

Ammoniation is a method of treating low-quality roughages to improve their nutritional value for ruminant animals. The method involves sealing this forage in a gas-tight, enclosed container and adding anhydrous liquid ammonia to the forage. This method can also be used to some extent to prevent molding of crop residues or high-moisture forages. At about 21 days, the chemical action is complete, and this product can be used for feed.

### Benefits of Ammoniation

Due to a high lignin content, straw is poorly utilized by ruminants. Ammoniation (sealing the forage in an air-tight system and injecting anhydrous ammonia) of crop residues can be a practical and economically feasible method of improving the feeding value of straw for beef cattle.

Ammonia treatment increases laboratory dry matter digestibility of straw 8 to 15 percentage units. By disrupting the fiber structure of the plant during the ammoniation process, greater rumen fermentation is allowed. Along with increased forage digestibility is an increase in the amount of forage dry matter that a cow can physically consume. Daily dry matter intake of straw can be increased 15 to 20 percent through ammoniation. With higher forage digestibility and intake, feed

efficiency, weight gain, and cow body condition can be improved.

Treatment of straw with anhydrous ammonia (non-protein nitrogen, NPN) raises the crude protein content of ammoniated forages. Keep in mind that NPN is not utilized as efficiently as natural protein. It has been shown that unless some form of energy supplement is fed in conjunction with the ammoniated straw, a utilizable crude protein value of 6 percent should be used when balancing rations for beef cattle. One other benefit of the ammoniation process is that ammonia acts as a preservative of high moisture forages by inhibiting mold growth.

The majority of ammoniation research has been done with straws because of their low protein and usually lower feeding value. Research has been done by Dan Doornbos et al. (1985) at the Northern Agricultural Research Center in Montana. His research involves feeding beef heifers during the winters of 1983-84 and 1984-85. The heifers, weighing about 500 pounds, began a 140-day feed trial after a short grazing and warmup period after fall weaning.

One group received the traditional growing ration fed at the rate of 20 pounds of corn silage, 2 pounds of rolled barley, and 5 pounds of alfalfa hay per head. The other group received 7 pounds of ammoniated wheat straw, 4 to 6 pounds of rolled barley, and 5 pounds of alfalfa hay per head daily. Growth goal was to gain 1.25 to 1.5 pounds daily so the heifers would breed normally as yearlings.

During the first winter's trial, temperatures were very low. Average daily gain of the heifers on corn silage dropped but was still in the target range. Gain of heifers on the ammoniated straw ration fell below a pound per day, however. They ate all they could, but rate of

<sup>1</sup>This process has not been cleared by the FDA as an approved practice. Users of this practice do so at their own risk.

passage of the straw limited intake. Once the weather warmed, the heifers compensated with gains of up to 2 pounds a day for a while. Heifers gained an average of 1.37 pounds per day on the ammoniated straw ration. Those on the corn silage ration averaged 1.68 pounds of daily gain.

The cost of gain with the ammoniated straw ration was 40.7 cents per pound; for the silage ration, 33.4 cents per pound. These heifers then were pastured together and artificially inseminated during a 21-day period. Cleanup bulls were used for 23 days. Pregnancy rates were the same for heifers fed both rations. Doornbos et al. (1985) found that the heifers got going as easily on ammoniated straw as those on corn silage.

The economics of an ammoniated straw ration depend upon the availability of anhydrous ammonia and straw. In areas where there are large amounts of small grains, the use of anhydrous ammonia could become practical.

In general, ammoniation improves feeding quality by increasing the amount of total digestible nutrients (TDN) available in the straw. It improves the amount of roughage that animals will consume, and it increases the crude protein equivalent.

Straw intended for ammoniation should contain at least 12 percent moisture, preferably 15 to 20 percent. Greater moisture allows more nitrogen in the feed. The feeding quality of the straw should be as follows:

- Wheat straw should have TDN value of at least 33 percent.
- Barley straw TDN value should be at least 38 percent.

You should submit a sample to a feed testing laboratory to assure the moisture content and feeding quality of your straw for adequate ammoniation. Moisture content can be determined by on-farm testing kits.

### When to Ammoniate

The efficiency of ammoniation depends on temperature. The higher the temperature, the better the results. Generally it is advisable to ammoniate early in the fall before temperatures become too cold. As mentioned, a relatively high moisture level is necessary for efficient ammoniation. This can be achieved by baling early in the morning after a heavy dew, or by baling as soon as possible after a rainfall. Another alternative, of course, is to add water to the straw as it is baled.

### Location for Ammoniation

Each stack or bale should be downwind some distance from buildings and cattle holding areas. Stacks should be accessible to farm machinery from all sides. Accessibility to both ends is important so that ammoniation pipes can be inserted. It is also useful to have enough shelter to reduce or prevent wind damage of the stacks.

### Covering the Stacks

The size or dimension of the straw stacks is determined by the size of the plastic sheet one can purchase. Six mil black polyethylene is available in various widths. The most useful sheets are 100 feet long by 40 feet wide. Stacks or piles can be constructed so that the overhang on each side is at least 2 feet, so the plastic can be sealed properly at the ground.

Hand-built bale stacks or bale wagon stacks can be used. Round bales can be stacked in rows, and chopped straw can be piled on the bales and covered with a sheet of plastic.

Any type of silo should be suitable for ammoniation if the ammoniated gas can be well dispersed throughout the straw. A trench silo is useful, because it requires less plastic per ton of straw and helps hold the heat generated by the ammoniation treatment.

When covering the stack, take care to avoid puncturing the plastic. Choose a day with no more than a light breeze blowing.

It may be advisable to hoist the roll onto the stack with a farmhand and unroll the plastic along the top of the stack and unfold it down the sides. In some cases it may be best to unroll the plastic on the ground and drag it over the stacks.

When the plastic has been positioned over the stack, place dirt or sandbags along one side. Tighten the plastic down on the other side and cover it. Then pull out the corners as if wrapping a parcel and fold across the end of the stack. Tape down all edges and pile dirt around all sides. Finally, if possible, cover stacks with a fishnet or camouflage net to avoid wind damage.

### Determining How Much Ammonia to Add

When 3.0 percent anhydrous ammonia, based upon the dry matter content of the residue, is added, let's assume that the stack to be ammoniated contains 1,500 bales weighing an average of 43 pounds each, and that the average moisture content of the straw is 12 percent.

Dry wt of straw =

$$\text{No. of bales} \times \text{avg. bale wt} \times (100 - \% \text{ moisture})$$

OR

$$1,500 \text{ bales} \times 43 \text{ lb} \times (100 - 12\%) =$$

$$56,760 \text{ lb or } 28.38 \text{ tons}$$

$$56,760 \text{ lb} \times 3.0\% = 1,703 \text{ lb of } \text{NH}_3$$

Volume of  $\text{NH}_3$  required =

$$\frac{\text{wt of } \text{NH}_3 \text{ (lb)} \times \text{density of } \text{NH}_3}{5.15 \text{ lb/gal}}$$

$$5.15 \text{ lb/gal}$$

OR

$$\frac{1,703 \text{ lb}}{5.15 \text{ lb/gal}} = 330.7 \text{ gallons (This method$$

$$\text{would require a metered pump.)}$$

If a nurse tank is used, determine the pounds in each 1 percent and reduce the percent as shown on the gauge the appropriate amount.

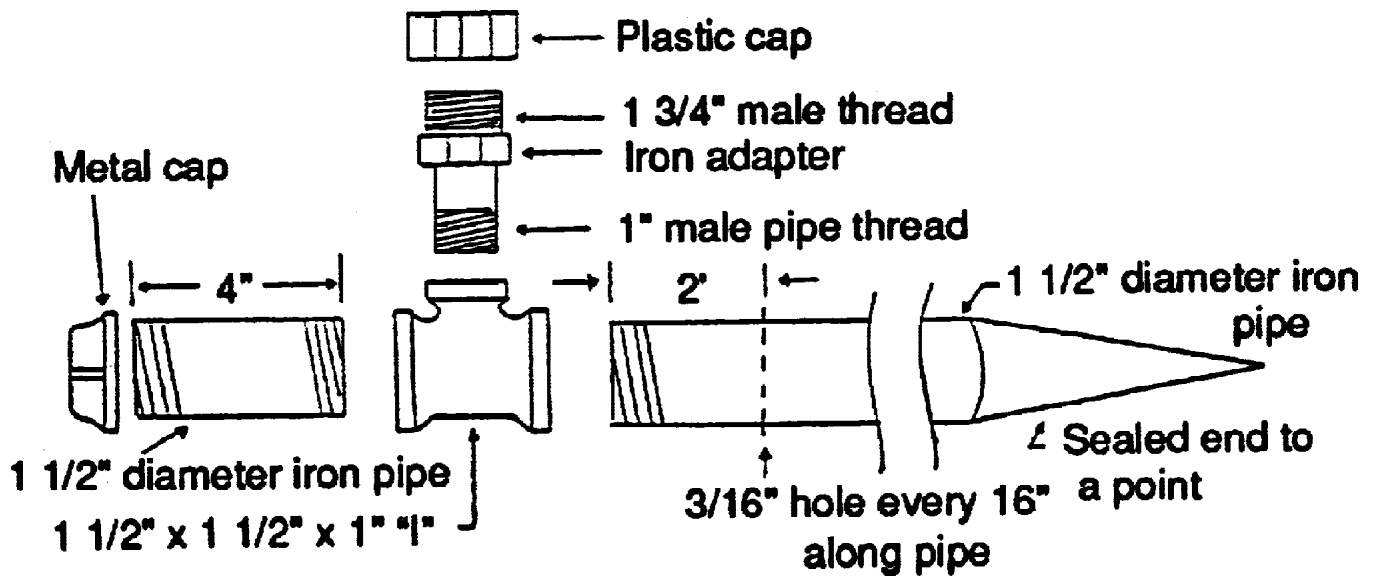


Fig. 1. Details of ammoniated pipe about 22 feet long.

After calculating the amount of ammonia to add, uncover a 3-foot length of plastic along the base of the stack half-way down one side. This allows air to escape from the enclosure as ammonia evaporates. Thus, the pressure within the enclosure does not build up, and anhydrous ammonia can be added more rapidly.

Pressurized liquid anhydrous ammonia is hazardous. This operation should be carried out by an experienced ammonia dealer. It is important to add the correct amount of ammonia. Too much means unnecessary expense, and too little will create a poor quality feed.

About 20 to 30 minutes after the ammonia has been added, the pipe can be removed. Be sure to wear goggles and insulated rubber gloves for protection from the ammonia residue.

As mentioned, ammonia process is complete in about 21 days. Leave the stack covered until a few days before the ammoniated straw is required for feeding. When opening the stack, be careful for exposure to ammonia gas that may still be present. Open the stack on a day when there is a slight breeze blowing away from the buildings and corrals. Leave the stack for a few days to allow all excess ammonia to evaporate. Animals will not consume feed that has a strong odor of ammonia.

The cost of treating straw with ammonia depends on the cost of the materials. These materials vary from year to year and within location. If materials are purchased at a competitive price and a large stack is treated, your cost for ammoniation could range from \$12 to \$17 per ton.

When formulating rations for either cattle or sheep, consult the drought guide sheets for that purpose.

### Ammoniation

Canadian researchers recommend using only iron pipes (Fig. 1). The pipe is pushed through the plastic with a tractor and adjusted so that holes point down to enable the pipe to drain free of liquid ammonia. Insert the pipe until it is just past the hole nearest the "T". Insert pipes into both ends of the stack if the stack is more than 20 feet long. Forty feet would be ideal with the 22-foot pipes sticking in each end.

### References

- Kernan, J., and J. Knipfel. No date. Ammoniation of straw and chaff, Factsheet, Agriculture Canada Swift Current Research Station.
- Doornbos, D. E., D. C. Anderson, and D. D. Kress. 1985. Anhydrous ammonia treated straw. *In: A growing ration for beef heifers. Proc. Western Section American Society of Animal Science.* p. 120.



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