Anhydrous Ammonia Fertilizer

Cooperative Extension South Dakota State University

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anhydrous ammonia fertilizer

Cooperative Extension Service
U. S. Department of Agriculture
South Dakota State University
Brookings
Anhydrous ammonia fertilizer

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Introduction
Agricultural use of anhydrous ammonia has increased significantly throughout both South Dakota and in the United States. It is one of the most economical fertilizer sources of nitrogen. Research shows it to be essentially equal to other forms of nitrogen fertilizer, pound for pound of actual nitrogen applied, in promoting plant growth.

Application

Time
Anhydrous ammonia can be effectively applied at different times during the year. It can be applied in the fall, in spring as preplant and as a sidedress, or as post-plant application. Toxic effects of anhydrous ammonia can cause delayed emergence or reductions in stands if seeds are placed too near the application zone right after the fertilizer is applied. Delaying planting at least 10 days after application will greatly reduce such injury.

Applying the ammonia diagonally with respect to row direction can also reduce injury. It can be applied after crops are seeded and growing, such as a sidedress application on row crops, or an injection into growing small grain. Sidedress applications on row crops should be made as soon as seedling rows can be seen, and before plants are 10 to 12 inches high. Delaying sidedressing until such crops are 15 to 20 inches tall frequently means the crop will not get maximum benefits from that fertilizer investment. Root pruning is also thought to restrict or adversely affect yields where sidedress applications are made too late in the growing season. Similarly, post-plant injections on small grain should be applied early in spring for best results.

Farmers are frequently discouraged from making fall applications of anhydrous ammonia until surface soil temperatures reach 50 degrees (F.) or below. Warmer soil temperatures hasten the rate at which this fertilizer material is converted into a form more easily leached. However, fall and overwinter leaching losses in South Dakota are thought to be insignificant because of limited rainfall and frozen condition of soil. For those reasons SDSU plant scientists suggest applications of anhydrous ammonia can be made any time in the fall, regardless of soil temperature, on most medium and fine textured soils.

Method
Anhydrous ammonia can be applied prior to or after planting as a separate treatment, or in combination with tillage operations. An increasing number of farmers have equipped moldboard plows, chisel plows, sweep-type implements, and other tillage equipment with anhydrous ammonia attachments that combine tillage and fertilizer application into one field operation. Vapor loss can occur during and after application if soil does not seal off and trap the gaseous fertilizer in soil. Soils can be both too dry and cloddy, as well as too wet. In either instance, poor sealing behind the injection knife permits vapors to escape. While soil moisture levels can be too high for good plowing, in general those considered ideal for plowing are also best for applying anhydrous ammonia.

Depth
Important losses of anhydrous ammonia can occur if depth of application is too shallow. This fertilizer should be placed 7 to 9 inches deep on most soils. Increased nitrogen loss can occur where more shallow placement is made. This is particularly true on very sandy soils or where nitrogen rates of perhaps 100 to 150 pounds per acre are applied on 38- to 40-inch interval spacing. Application depth can be slightly reduced where interval spacing is closer or where lower application rates are used.

In some instances, operators inject anhydrous ammonia first and then plow the field. Gaseous nitrogen loss has been reported on soils with similar pH values as those in South Dakota, where the ammonia-saturated soil is tilled or plowed and exposed to the air too soon after application. For that reason, operators are encouraged to delay tillage following application at least 10 days to minimize such loss. Conversion of ammonia in soil into forms not subject to gaseous loss has been shown to be virtually complete in 4 to 8 weeks. In that way, time can minimize loss.

Farmers may also reduce loss by using narrow injection intervals and reduce injection depth to half the normal plowing depth. This would hopefully keep the main fertilizer concentrations still 3 to 4 inches deep after plowing instead of on or near the soil surface. It is felt nitrogen losses from such shallow injections would be less than if the material was injected deep and then exposed to the atmosphere.

Rates
Application rates should be based on soil tests and yield potentials. Recommended rates will vary widely depending on soil type, management, and crops to be grown. Recommended nitrogen rates based on soil tests can be found in various South Dakota fact sheets. These include: FS 432 "Fertilizing Corn and Sorghum," FS 435 "Fertilizing Small Grain," and FS 425 "Fertilizing Pastures and Hayland."
Properties
Table 1 lists some of the properties of anhydrous ammonia. For example, it is colorless in gaseous form; the cloud you see when it is released to the air is actually a condensed water vapor cloud resulting from the cooling effect of the liquid changing to a gas. The gas is compressed into liquid form for easier storage and transfer. The material boils at -28 degrees (F.) under atmospheric conditions, meaning it changes from a liquid to a gas as material temperatures rise above -28 degrees. It can be seen from Table 2 that potentially very high pressures can develop inside tanks as fertilizer temperature increases. For this reason special storage and application equipment are required. This reemphasizes the need for using safe operating procedures and equipment; however, this is also true for every agricultural chemical.

The liquid is caustic and capable of burning both internal and external body tissue. Immediate thorough washing for 15-20 minutes can greatly reduce or even prevent personal injury. The strongly pungent odor of the vapor is so unpleasant that operators cannot voluntarily remain in areas of even moderate concentrations, let alone those levels where injury from suffocation could occur.

SAFETY
Accidental exposure to high concentrations of anhydrous ammonia can be injurious. However, injury can be minimized or even prevented if certain safety precautions are followed. Keep in mind that high concentrations can be caustic to skin if not washed off or diluted with large volumes of water right away. In fact, only a 2% concentration of ammonia gas is generally the maximum tolerated by the skin for more than a few seconds. Freezing action, upon direct contact with the evaporating liquid, can also cause skin burn. However, use of proper clothing, gear, and transfer technique can practically eliminate accidental exposure. The following safety guidelines are recommended:

- Travel crosswind to source, operate upwind if possible.
- Have large volumes of water readily available.

Anhydrous ammonia requires special storage and handling equipment, yet it is one of the most economical forms of nitrogen fertilizer.

Trailing the dealer supply tank behind applicator saves time and costs compared to transferring the fertilizer from the supply tank to applicator tank.
• Thoroughly wash exposed victims with water (15-20 minutes).
• Do not apply burn salve to exposed tissue.
• Evacuate downwind residents.
• Avoid flushing water-ammonia mixture into sewer.
• Don't spray water on puddles of liquid ammonia.
• Use water shield (hose) to gain access to victims, valves, etc.
• Check replacement needs of equipment before heavy use period.
• Use goggles and rubber gear (gloves, etc.) when transferring material.

Table 1. Characteristics of anhydrous ammonia

<table>
<thead>
<tr>
<th>Weight per gallon (@ 60° F.)</th>
<th>5.15 lbs.</th>
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<tbody>
<tr>
<td>The liquid expands 846 times its original volume as it changes to a gas.</td>
<td></td>
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<tr>
<td>Caustic to external and internal body tissue.</td>
<td></td>
</tr>
<tr>
<td>Dissolves readily in water (including perspiration).</td>
<td></td>
</tr>
<tr>
<td>Gas vapor is colorless.</td>
<td></td>
</tr>
<tr>
<td>Odor—strongly pungent.</td>
<td></td>
</tr>
<tr>
<td>Flammable when concentration is 16% to 25%.</td>
<td></td>
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</tbody>
</table>

Table 2. Vapor pressure of anhydrous ammonia varies with temperature.

<table>
<thead>
<tr>
<th>NH₃ Temperature Degrees/Fahrenheit</th>
<th>Pressure PSI</th>
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<tbody>
<tr>
<td>-28</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>15.7</td>
</tr>
<tr>
<td>32</td>
<td>47.6</td>
</tr>
<tr>
<td>60</td>
<td>92.9</td>
</tr>
<tr>
<td>100</td>
<td>197.2</td>
</tr>
<tr>
<td>125</td>
<td>293.1</td>
</tr>
<tr>
<td>130</td>
<td>315.6</td>
</tr>
</tbody>
</table>

Use of a tradename does not imply endorsement of one brand over another.

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