

Nutrient Source SPECIFICS

Ammonia

No. 10

Ammonia (NH₃) is the foundation for the nitrogen (N) fertilizer industry. It can be directly applied to soil as a plant nutrient or converted into a variety of common N fertilizers. Special safety and management precautions are required.

Production

Almost 80% of the Earth's atmosphere is composed of N_2 gas, but it is in a chemically and biologically unusable form. In the early 1900s, the process for combining N_2 and hydrogen (H_2) under conditions of high temperature and pressure was developed. This reaction is known as the Haber-Bosch process: $[3H_2 + N_2 \rightarrow 2 \text{ NH}_3]$

A variety of fossil fuel materials can be used as a source of H₂, but natural gas (methane) is most common. Therefore, most NH₃ production occurs in locations where there is a readily available supply of natural gas.

Ammonia is a gas in the atmosphere, but is transported in a liquid state by compressing or refrigerating it below its boiling point (-33 °C). It is shipped globally in refrigerated ocean vessels, pressurized rail cars, and long-distance pipelines.

Chemical Properties

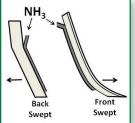
Ammonia (NH₃)

N Content 82% N

Boiling Point -33 °C (-27 °F)

Aqua Ammonia (NH₄OH)

N Content 20 to 24% N pH 11 to 12





Agricultural Use

Ammonia has the highest N content of any commercial fertilizer, making it a popular source of N despite the potential hazard it poses and the safety practices that are required for its use. When NH₃ is applied directly to soil, it is a pressurized liquid that immediately becomes a vapor after leaving the tank. Ammonia is always placed at least 10 to 20 cm (4 to 8 in.) below the soil surface to prevent its loss as a vapor back to the atmosphere. Various types of tractor-drawn knives and shanks are used to place the NH₃ in the correct location. Ammonia will rapidly react with soil water to form ammonium (NH₄⁺), which is retained on the soil cation exchange sites. Ammonia is sometimes dissolved in water to produce "aqua ammonia", a popular liquid N fertilizer. Aqua ammonia does not need to be injected as deeply as NH₃, which provides benefits during field application and has fewer safety considerations. Aqua ammonia is frequently added to irrigation water and used in flooded soil conditions.

Management Practices

Handling NH₃ requires careful attention to safety. At storage facilities and during field application, appropriate personal protection equipment must be used. Since it is very water soluble, free NH₃ will rapidly react with body moisture, such as lungs and eyes, to cause severe damage. It should not be transferred or applied without adequate safety training.

Immediately after application, the high NH_3 concentration surrounding the injection site will cause a temporary inhibition of soil microbes. However, the microbial population recovers as NH_3 converts to NH_4^+ , diffuses from the point of application, and then converts to nitrate. Similarly, to avoid damage during germination, seeds should not be placed in close proximity to a recent zone of NH_3 application. Inadvertent escape of NH_3 to the atmosphere should be avoided as much as possible. Emissions of NH_3 are linked to atmospheric haze and changes in rain water chemistry. The presence of elevated NH_3 concentrations in surface water can be harmful to aquatic organisms.

Non Agricultural Uses

Over 80% of NH₃ production is used for fertilizer, either for direct application or converted to a variety of solid and liquid N fertilizers. However, there are many important uses for NH₃ in industrial applications. Household cleaners are made from a 5 to 10% solution of NH₃ dissolved in water (to form ammonium hydroxide). Because of its vaporization properties, NH₃ is used widely as a refrigerant.



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Nutrient Source Specifics is a series of brief, condensed fact sheets highlighting common fertilizers and nutrient sources in modern agriculture. These topics are written by scientific staff of the International Plant Nutrition Institute (IPNI) for educational use. Mention of a fertilizer source or product name does not imply endorsement or recommendation. This series is available as PDF files at this URL: >www.ipni.net/specifics<