

## Ammonium Sulfate

Ammonium sulfate  $[(NH_4)_2SO_4]$  was one of the first and most widely used nitrogen (N) fertilizers for crop production. It is now less commonly used, but especially valuable where both N and sulfur (S) are required. Its high solubility provides versatility for a number of agricultural applications.

### Production

Ammonium sulfate (sometimes abbreviated as AS or AMS) has been produced for over 150 years. Initially, it was made from ammonia released during manufacturing coal gas (used to illuminate cities) or from coal coke used to produce steel. It is made from a reaction of sulfuric acid and heated ammonia. The size of the resulting crystals is determined by controlling the reaction conditions. When the desired size is achieved, the crystals are dried and screened to specific particle sizes. Some materials are coated with a conditioner to reduce dust and caking.



$(NH_4)_2SO_4$  crystals

Most of the current demand for ammonium sulfate is met by production from by-products of various industries. For example, ammonium sulfate is a co-product in the manufacturing process of nylon. Certain by-products that contain ammonia or spent sulfuric acid are commonly converted to ammonium sulfate for use in agriculture. Although the color can range from white to beige, it is consistently sold as a highly soluble crystal that has excellent storage properties. The particle size can vary depending on its intended purpose.

### Agricultural Use

Ammonium sulfate is used primarily where there is a need for supplemental N and S to meet the nutritional requirement of growing plants. Since it contains only 21% N, there are other fertilizer sources that are more concentrated and economical to handle and transport. However, it provides an excellent source of S which has numerous essential functions in plants, including protein synthesis.

Because the N fraction is present in the ammonium form, ammonium sulfate is frequently used in flooded soils for rice production, where nitrate-based fertilizers are a poor choice due to denitrification losses.

A solution containing dissolved ammonium sulfate is often added to post-emergence herbicide sprays to improve their effectiveness at weed control. This practice of increasing herbicide efficacy with ammonium sulfate is particularly effective when the water supply contains significant concentrations of calcium, magnesium, or sodium. A high-purity grade of ammonium sulfate is often used for this purpose to avoid plugging spray nozzles.

### Management Practices

After addition to soil, the ammonium sulfate rapidly dissolves into its ammonium and sulfate components. If it remains on the soil surface, the ammonium may be susceptible to gaseous loss in alkaline conditions. In these situations, incorporation of the material into the soil as soon as possible...or application before an irrigation event or a predicted rainfall...is advisable.

Most plants are able to utilize both ammonium and nitrate forms of N for growth. In warm soils, microbes will rapidly begin to convert ammonium to nitrate in the process of nitrification  $[2 NH_4^+ + 3O_2 \rightarrow 2NO_3^- + 2H_2O + 4H^+]$ . During this microbial reaction, acidity  $[H^+]$  is released, which will ultimately decrease soil pH after repeated use. Ammonium sulfate has an acidifying effect on soil due to the nitrification process...not from the presence of sulfate, which has a negligible effect on pH. The acid-producing potential of ammonium sulfate is greater than the same N application from ammonium nitrate, for example, since all the N in ammonium sulfate will be converted to nitrate, while only half of the N from ammonium nitrate will be converted to nitrate.

### Non Agricultural Uses

Ammonium sulfate is commonly added to bread products as a dough conditioner. It is also a component in fire extinguisher powder and flame-proofing agents. It is used for many applications in the chemical, wood pulp, textile, and pharmaceutical industries.

### Chemical Properties

Chemical formula:	$(NH_4)_2SO_4$
N content:	21%
S content:	24%
Water solubility	750 g/L
Solution pH	5 to 6