**CHEMICAL ANALYSIS**

*(Ammonium sulphate obtained via FiberPlus with use of gypsum)*

**Ammonium sulphate solution 5 (+6)**
- 5 % (± 0.5 %) N water-soluble ammonium nitrogen
- 6 % (± 0.5 %) S water-soluble sulphur

**Solution: typical properties**
- Density: 1.1 kg/l
- pH: 6.5 bis 7.8

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**CHEMICAL ANALYSIS**

*(Ammonium sulphate obtained via other type of stripping and/or scrubbing with H₂SO₄)*

**Ammonium sulphate solution 8 (+9)**
- 8 % (± 0.5 %) N water-soluble ammonium nitrogen
- 9 % (± 0.5 %) S water-soluble sulphur

**Solution: typical properties**
- Density: 1.2 kg/l
- pH: 4 bis 7

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**Description**

Ammonium sulphate solution - (NH₄)₂SO₄ solution - is a mineral nitrogen/sulphur fertiliser derived from anaerobic digestate using calcium sulphate (CaSO₄) or sulphuric acid (H₂SO₄) as a scrubber agent.

(NH₄)₂SO₄ solution contains all nutrients in a fully water-soluble form, which are therefore directly available to the plants. The combination of N and S enables a demand-based supply for the plants with both nutrients, suitable for all kinds of agriculture (except organic farming). (NH₄)₂SO₄ solution is an ideal fertiliser for plants that are in need of high S amount, such as grassland, rapeseed, maize, rye, wheat, cabbage, onions, celery and sugar beets.

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**Application**

The (NH₄)₂SO₄ solution is a N containing S fertiliser. Meaning, N fertilisation limits must be taken into account during its application, and the use should be guided by the fertility status of the soil. It is recommended to apply (NH₄)₂SO₄ solution during the early growth phase of the plant, e.g. for maize this will be at the stage that the plant has 3-4 leaves.

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For application methods, row placement and injection are considered to be better than broadcast spraying for the following reasons:

- broadcast spraying is not advisable – especially on alkaline soil, as it increases the risk for ammonia volatilisation;
- the local placement of (NH₄)₂SO₄ solution (through row placement or injection) leads to local elevated concentrations of ammonium N, and elevated concentrations reduce the nitrification rate;
- it is advised to apply (NH₄)₂SO₄ solution in the vicinity of the roots as this reduces the potential volatilisation and plant burning. However, the fertiliser should not be placed too close to the roots as ammonium toxicity can occur.

Another option is to apply (NH₄)₂SO₄ solution (5% N and neutral pH) directly to the leaves, e.g. with a plant sprayer, because the plants tolerate the neutral pH value well and the fertiliser salt concentration of 25% avoids crystallisation by evaporation. This, however, is not applicable for (NH₄)₂SO₄ solution with other characteristics (e.g. 8% N and acidic pH) as the risk of scorching (or etching) would be high. Finally, it is not advised to apply (NH₄)₂SO₄ solution on days where there is rain, in autumn or in winter to avoid potential leaching of sulphur and nitrate.

In general, the lower pH of (NH₄)₂SO₄ solution does not influence the soil pH since soil has a buffer capacity which is determined by the organic matter content and the clay content in the soil that counteracts sudden pH fluctuations. In optimal soil management, a farmer can maintain his soil pH, for example through liming. Furthermore, the (NH₄)₂SO₄ solution might stimulate P absorption by the more acidic environment in the root zone. Since P stimulates root development, this is an added benefit of the product if applied in the vicinity of plant roots.

Blends of (NH₄)₂SO₄ solution with other fertilisers like ammonium nitrate, urea, potassium salts and ammonium phosphate are possible. These blends have to be treated differently as (NH₄)₂SO₄ solution contains lower concentrations of N, and hence application with machinery should be done at a slower rate (i.e. driving slower with machinery) or (NH₄)₂SO₄ solution should be applied several times to reach the desired application rate. Therefore this product is especially interesting in combination with other fertilisers such as urea or as top dressing. However, possible chemical reactions must be taken into account. When adding dissolved calcium salts, gypsum can crystallise out. Moreover, ammonia gas is released by adding strong alkaline substances or by the alkalinity of the soil. Finally, never mix (NH₄)₂SO₄ solution with animal manure as this would create dangerous H₂S gas, which is toxic and can be lethal to humans and animals even in low concentrations.

A combination with pesticides is possible in individual cases, but needs to be checked on a case-by-case basis. Adding micronutrients to (NH₄)₂SO₄ solution in low quantities is possible. To avoid problems it is recommended to make tests with low amounts of micronutrients.

### Recommendation

Recommendations of the fertiliser ordinance and official advice have priority.

The application rate of ammonium sulphate solution depends on:

- the S requirement of the crop or crop rotation
- the N requirement of the crop or crop rotation
- the amount of mineral N present in the soil (N₀ method)
- the quantity of nutrients applied through organic fertilisers.

The values shown in the table can be taken as a guideline for the fertilisation of some important crops. Organic manures are not taken into account.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Application rate</th>
<th>S requirement</th>
<th>N requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>150 - 230 kg N ha⁻¹</td>
<td>10 - 20 kg S ha⁻¹</td>
<td></td>
</tr>
<tr>
<td>Oilseed rape</td>
<td>200</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Corn, maize</td>
<td>180</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Sugar beet</td>
<td>160</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Grassland</td>
<td>200 - 400 kg N ha⁻¹</td>
<td>0 - 40 kg S ha⁻¹</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>251 - 300</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>340 - 350 kg N ha⁻¹</td>
<td>50-80 kg S ha⁻¹</td>
<td></td>
</tr>
<tr>
<td>Leek</td>
<td>227 - 240 kg N ha⁻¹</td>
<td>24</td>
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</tbody>
</table>
Storage

Storage tanks are to be designed in accordance with water regulations. They must be designed in such a way that uncontrolled leakage of liquid can be ruled out.

\((\text{NH}_4)_2\text{SO}_4\) solution has a corrosive effect on concrete. Copper, brass or zinc, which are used for example as corrosion protection on sheet steel, can get damaged by \((\text{NH}_4)_2\text{SO}_4\) solution and are therefore unsuitable for storage and transport. Galvanized iron is also not suitable for the \((\text{NH}_4)_2\text{SO}_4\) solution. Steel alloys, plastics (PVC, nylon, PE, Polyester), nozzles (ceramic, plastic or stainless steel) are suitable materials for storage and application of the product.

\((\text{NH}_4)_2\text{SO}_4\) solution with a concentration of 25% is storage-stable down to \(-5\) °C. At lower temperatures, solid \((\text{NH}_4)_2\text{SO}_4\) can crystallise. The process is reversible, meaning the precipitate will dissolve again when the temperature increases.

Relevant regulations

No suitability for organic farming, because \(\text{N}_{\text{mineral}} > 90\ \% \text{N}_{\text{total}}\). Fertilisers for organic farming cannot have more than 15% of the total N in easily soluble form (i.e. the sum of nitrate, ammonium and urea \(\leq 15\%\)).

In some European regions, such as Flanders (Belgium), the Netherlands and Germany, \((\text{NH}_4)_2\text{SO}_4\) solution from chemical air scrubbers has been recognised as a fertilising product: meaning, it can be applied on top of the 170 kg N / ha / y coming from animal manure.

In Germany \((\text{NH}_4)_2\text{SO}_4\) solution from end-of-pipe stripping/scrubbing technology has also been recognized as a fertilising product. This is not the case for Flanders (Belgium) and the Netherlands where solution from end-of-pipe stripping/scrubbing technology is designated as an animal manure and falls under the limit of 170 kg N / ha / y. Similar legal interpretation would be considered for the mixture of \((\text{NH}_4)_2\text{SO}_4\) solution and animal manure, plus this would lead to generation of a toxic and dangerous \(\text{H}_2\text{S}\) gas.