

Market opportunities for advanced bio-refinery products from digestate

Ammonium Sulphate and Ammonium Nitrate in the Chemical industry

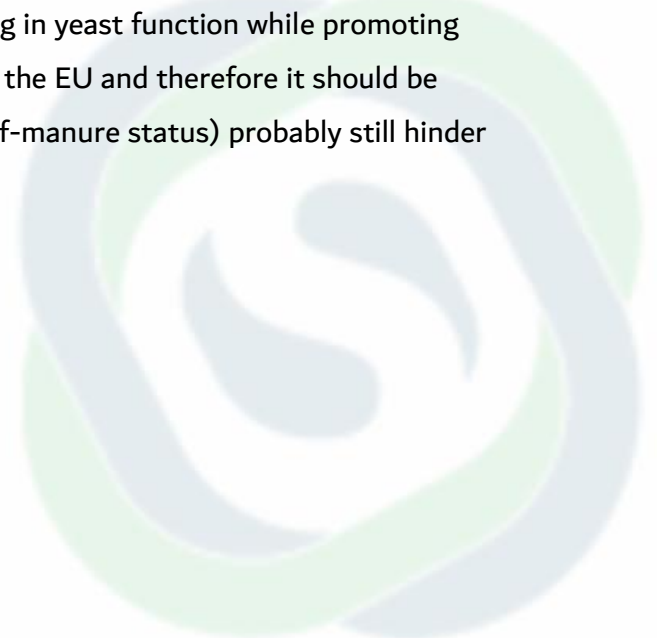
In 2018, **ammonium sulphate** was used mainly (95% of world consumption) as a nitrogen fertiliser material. Industrial use of ammonium sulphate accounts for only about 5% of world consumption.

Ammonium sulphate is produced as a crystal by three different processes: (1) synthetic manufacture from pure ammonia and concentrated sulfuric acid, as a by-product of gas cleaning in coke and coal gasification plants, (3) from ammonia scrubbing of tail gas at sulfuric acid (H₂SO₄) plants, and (4) as a by-product of the production of caprolactam ((CH₂)₅COHN), Methyl Methacrylate and acrylonitrile (GEA 2010).

Recently, the world-wide supply of ammonium sulphate has increased somewhat, in part due to the production of ammonium sulphate by direct reaction crystallization from (spent) sulfuric acid and ammonia. The additional production capacity of ammonium sulphate has not been sufficient to satisfy the market requirements, therefore there is still room for recovered ammonium sulphate (GEA 2010).

As one might expect, the price of ammonium sulphate varies with the purity and particle size of the crystals, i.e. small crystals (< 1mm) are worth 3 times less than larger “granular” ones (2-3 mm).

Other industrial applications include leather, textiles, flame retardants. In baking applications, it functions as a dough conditioner and dough strengthener in bread products. It supplies nitrogen to the yeast for nourishment aiding in yeast function while promoting browning. It is recognised as a food additive (E515) in the EU and therefore it should be food grade quality and the legal constraints (i.e. end-of-manure status) probably still hinder its use as food additive.



Ammonium nitrate (AN) is used as hardener in the production of fibreboards and MDF. In the production of fibreboards, a long processing time is needed for mixing the raw material (wood) and the glue. Also, the adhesive must dry quickly during pressing to achieve a high production speed. This is possible by adding a temperature-sensitive hardener to the adhesive. As hardeners, ammonium salts, such as ammonium nitrate, sulphate, etc. are usually added to the glue (except for PF glue).

The release of acids lowers the acidity (pH), which promotes the drying of the glue. The choice and amount of hardener depends on the process conditions. Without the addition of a hardener, the number and complexity of the process conditions increases. In order to slow down the drying before pressing, ammonia is added as buffer substance.

Some producers of wood boards have expressed interest in AN solution or crystals as secondary raw material. Sometimes ammonium sulphate is used because this is cheaper, but AN is preferred because it is more stable and performant.

Yet, they require the product to have no impurities and they cannot specify which elements exactly are considered as impurity. Therefore, they would like to do some tests with the product (minimum 40%N) first and they would currently they need 3000 ton AN solution/year and no minimum volume supply is required.

If the product meets the requirements, a competitive price has to be negotiated.

Ammonium nitrate solutions with more than 28% nitrogen by weight compared to ammonium nitrate must successfully pass the detonation test defined in (EC) Regulation n° 2003/2003 In order to be free in circulation in the internal market (Seveso-inspectiediensten 2009). They must also meet a certain number of technical requirements regarding their porosity, the size of the particles, the pH and the percentage of impurities (e.g. a very low limit for organic substances).

Ammonium nitrate could be a precursor for explosives when the water is removed by evaporation (Regulation (EU) No 98/2013 on the marketing and use of explosives precursors). Again, a very high purity is required which may be a limiting factor. Recovered ammonium products typically have a strong odour.

References

GEA. 2010. "Ammonium Sulfate."

Seveso-inspectiediensten, Belgische. 2009. *Inspectie-Instrument Ammoniumnitraat.*