Perpetual Solutions

Introduction to Di-Ammonium Phosphate (DAP)

Introduction

- ✓ Diammonium phosphate (DAP) chemical formula $(NH_4)_2HPO_4$
- ✓ **IUPAC Name** → Di-ammonium hydrogen phosphate
- ✓ It is one of a series of water-soluble ammonium phosphate salts that can be produced when ammonia reacts with phosphoric acid.
- ✓ The typical formulation is 18-46-0 (18% N, 46% P_2O_5, 0% K_2O).
- ✓ At 100°C, the dissociation pressure of diammonium phosphate is approximately 5 mm Hg.
- ✓ Accordingly, to MSDS of Di-Ammonium Phosphate from CF Industries inc. decomposition starts as low as 70°C.

Properties

Chemical Formula	$(NH_4)_2HPO_4$
Molar Mass	132.06 g/mol
Appearance	White powder
Density	1.619 g/cm³
Melting Point	155 °C (311 °F; 428 K) decomposes
Solubility in Water	57.5 g/100 mL (10 °C) 106.7 g/100 mL (100 °C)
Solubility Nature	Insoluble in alcohol, acetone and liquid ammonia
Refractive index (np)	1.52

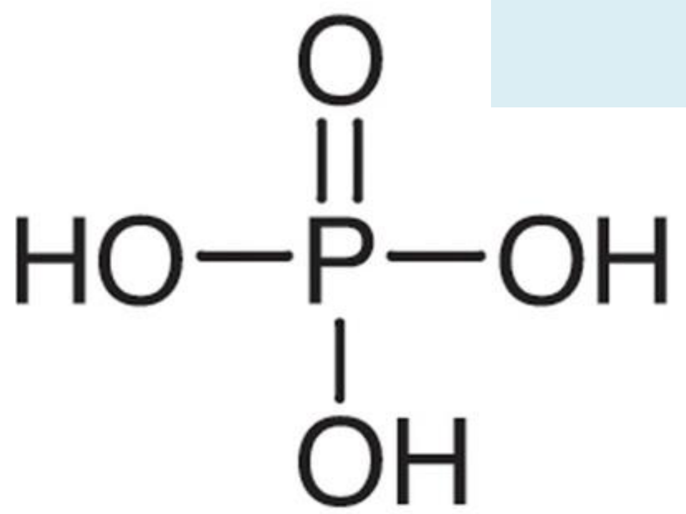
Other anions: Monoammonium phosphate, Triammonium phosphate

Other cations: Disodium phosphate, Dipotassium phosphate

Raw Materials for DAP Production

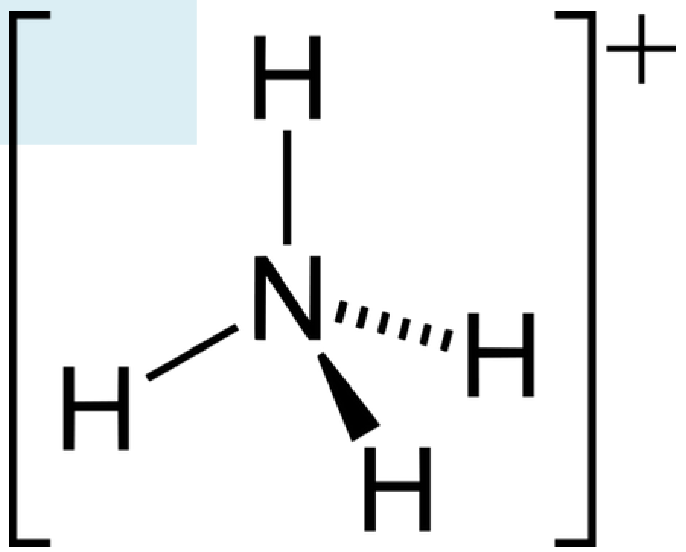
Phosphoric Acid

The raw material is Phosphoric Acid (H3PO3) produced from phosphate rock, a mineral deposit containing phosphorus compounds extracted from the earth's crust.



Ammonia

Anhydrous ammonia (NH3), produced from natural gas, is the other essential raw material that reacts with the phosphoric acid to form DAP.



Chemical Reaction

$$NH_3 + H_3PO_4 \rightarrow (NH_4)_2HPO_4$$

- Composition: 18% N, 46% P_2O_5 (20% P)
- Water solubility (20°C): 588 g/L
- Solution pH: 7.5 to 8

Manufacturing Steps

Perpetual Solutions

1) Pre - neutralization of H3PO4 with ammonia

2) Ammonia granulation (Ammoniation of MAP)

3) Scrubbing

4) Drying and cooling

5) Screening

6) Packing & Storage

Pre-neutralization

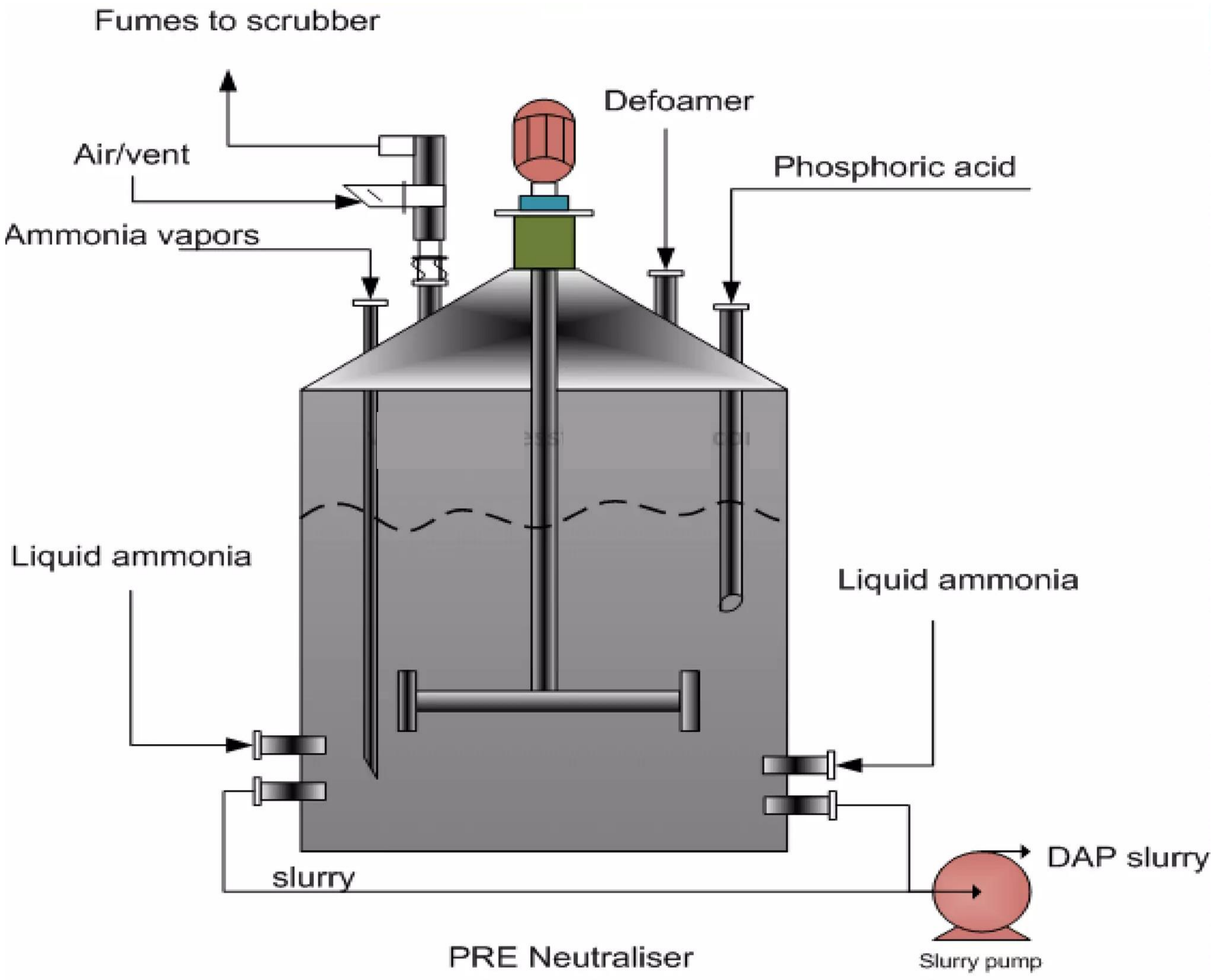
In this section, purified Phosphoric acid and ammonia react to each other in the presence of small amount of water to give 10-25% Mono-Ammonium Phosphate.

Temperature at this stage must be controlled in between 220-250°C

Reactions which takes place in Pre-Neutralizer

$$NH_3 + H_3PO_4 \xrightarrow[250°C]{H_2O} NH_4H_2PO_4$$

$$NH_4H_2PO_4 + NH_3 \longrightarrow (NH_4)_2HPO_4$$

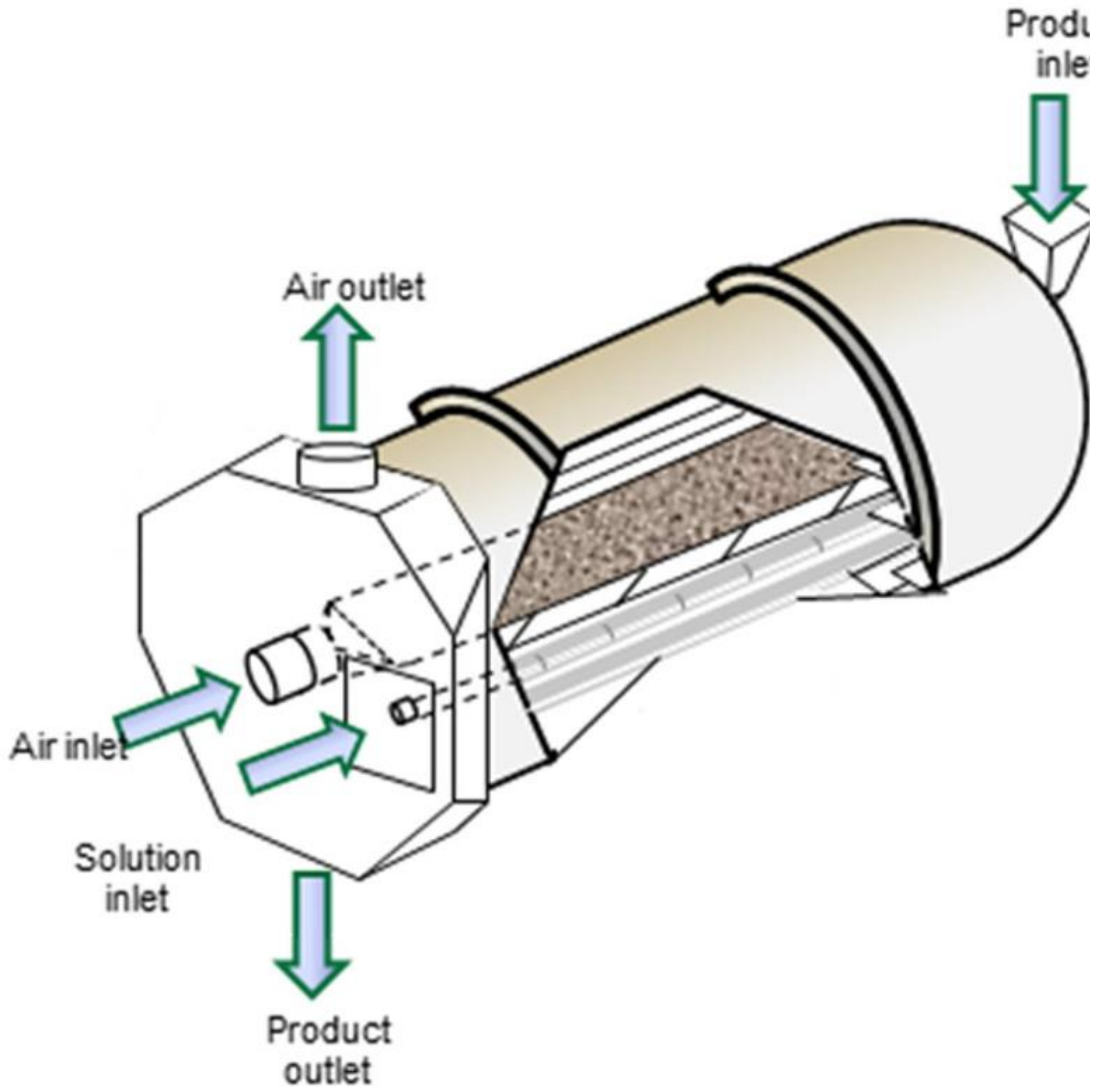


Ammonia Granulation

- In this section, Mono-ammonium phosphate is treated with more ammonia to form Di-ammonium phosphate

$$NH_4H_2PO_4 + NH_3 \longrightarrow (NH_4)_2HPO_4$$

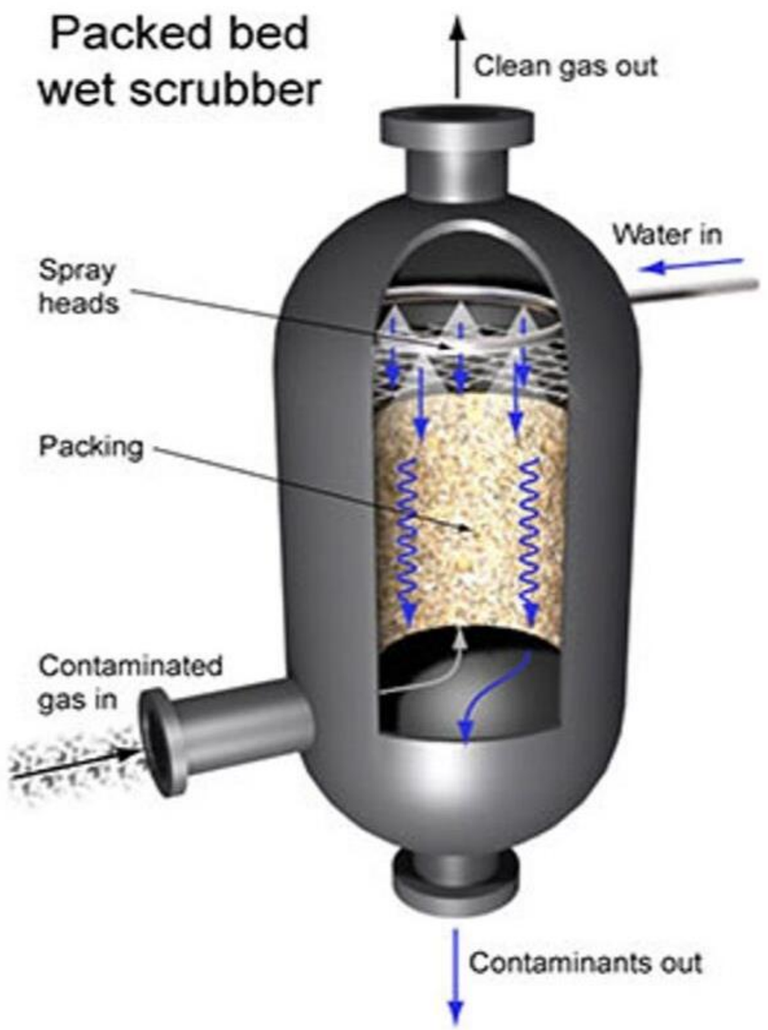
- The process is completed in ammonia granulator.
- During process sometime KCL, $(NH_4)_2CO_3$ or Urea are added to make the fertilizer in solid form.
- KCL, (NH4)2CO and Urea act as filler and help in easier solidification of fertilizer.



Schematic of a fluidized drum granulator

Scrubbing

The unreacted ammonia gas along with acid vapors are passed through Scrubber, where these are scrubbed in HIPO and taken to neutralization section in the form of Mono-ammonium phosphate.
The un-scrubbed gases are escaped out.

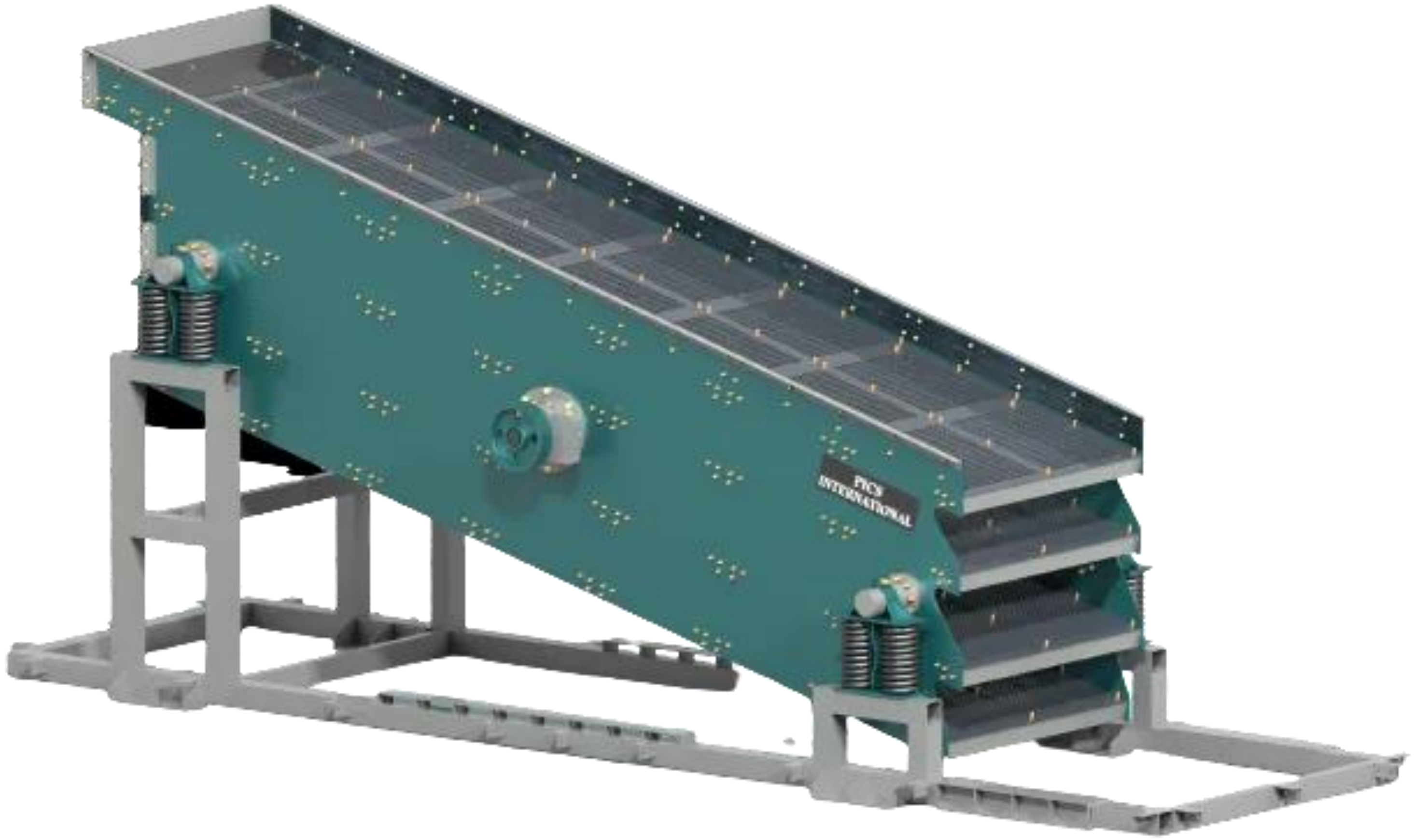


Drying

The product from ammonia granulates is passed through this section, here granules are dried with hot air.
The DAP granules are dried in a large rotary drum to remove excess moisture.

Cooling

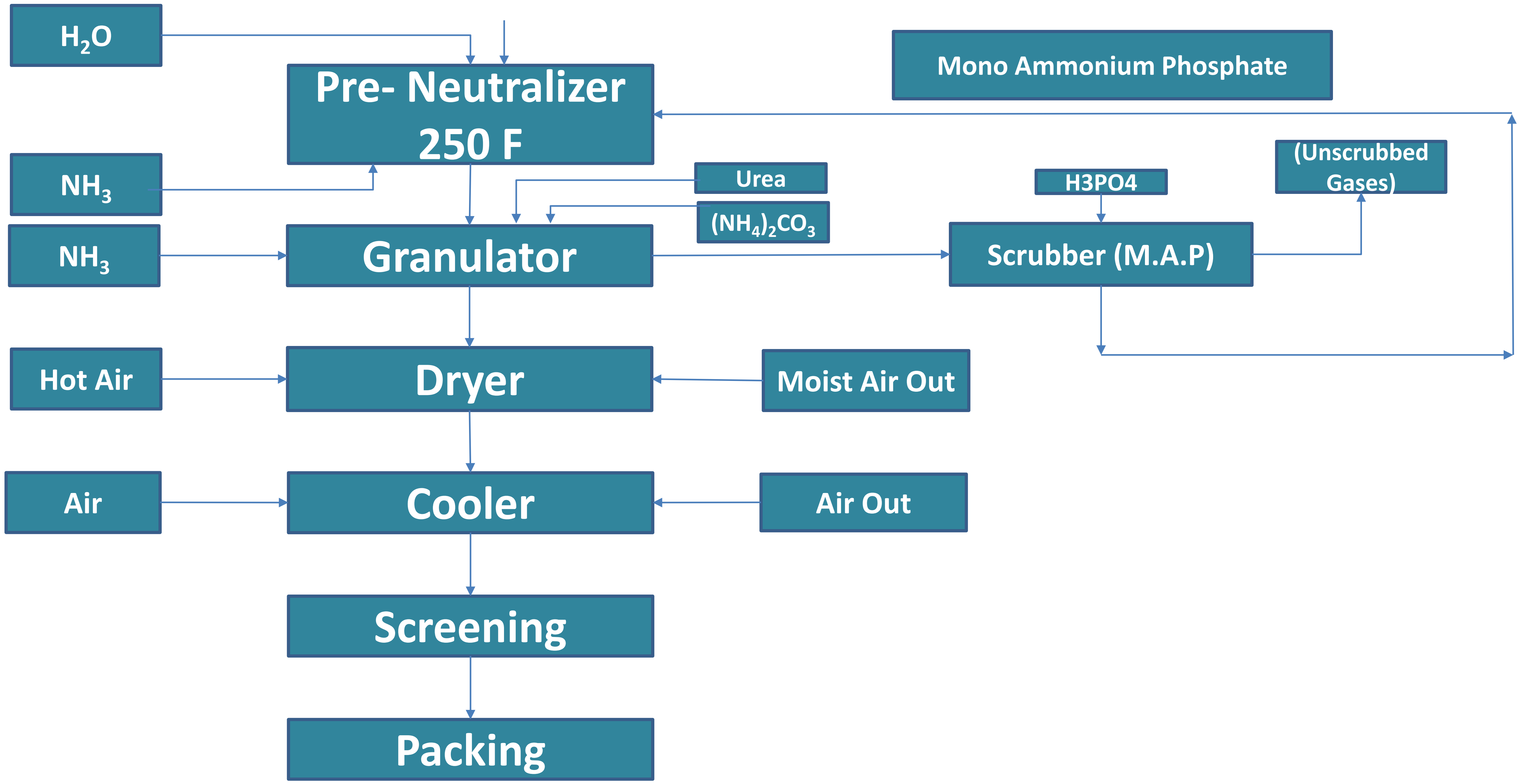
After Drying there is a cooler which cools down the temperature of dried hot [DAP] by passing cool air and after cooling [DAP] is sent to next section. The dried granules are then cooled to ensure they are stable and ready for packaging.



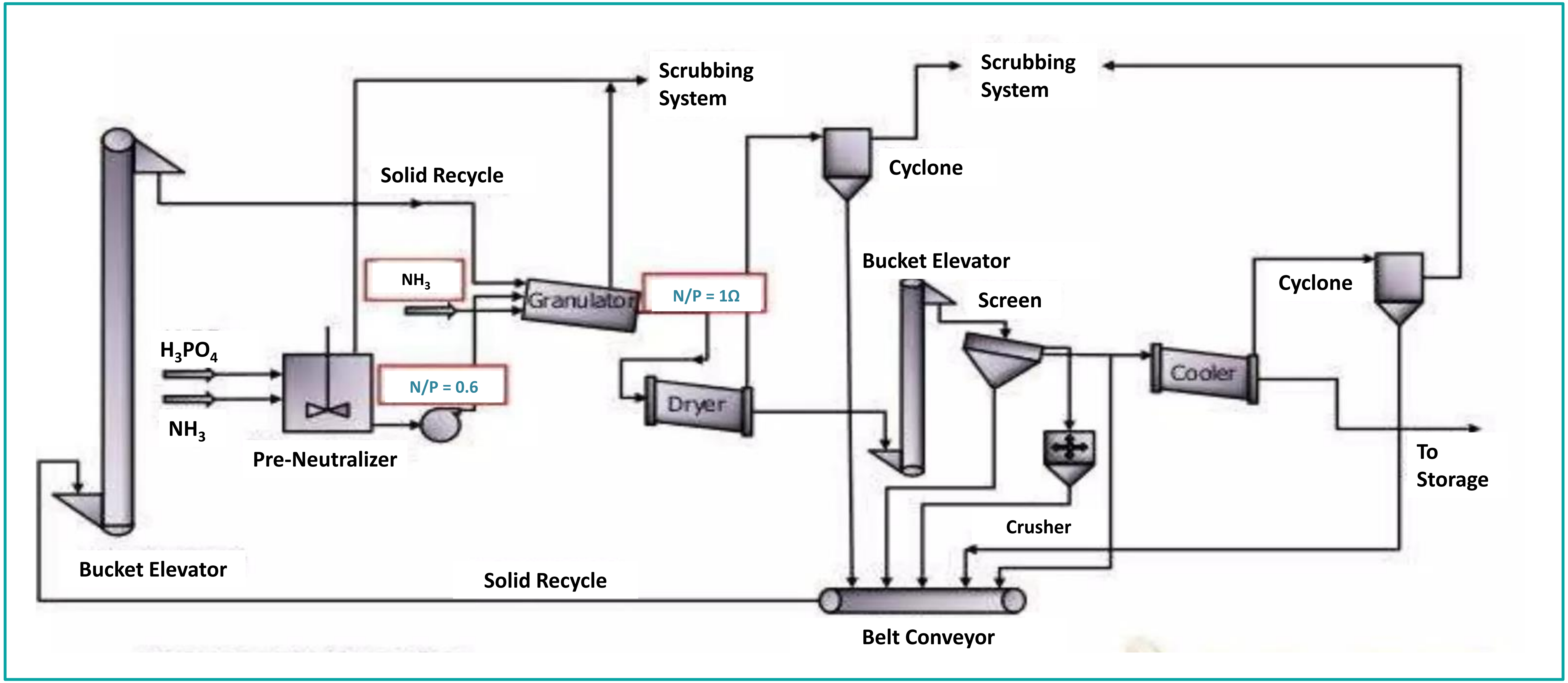
Screening & Packing

DAP is passed through vibrating screens where required size grains are separated while over-size and under-size are recycled. The screened DAP is now packed in bags and stored

Block Diagram of Manufacturing of Di-Ammonium Phosphate



Process flow diagram of Manufacturing of Ammonium Phosphate



Unit Operation

Perpetual Solutions

Introducing H3PO4, Ammonia & Water in the neutralization section.

- Conveying MAP to the reactor.
- Maintaining temperature in neutralizer.
- Introducing Urea, Ammonia, KCl in granulator.
- Scrubbing if un-reacted gases.
- Recycling of MAP from scrubber to process,
- Drying of Di-Ammonium Phosphate (DAP).
- Cooling of Di-Ammonium Phosphate.
- Screening & packing of di-Ammonium Phosphate (DAP).

Unit Process

- Formation of Mono-Ammonium phosphate (MAP)
- Formation of Di-Ammonium Phosphate (DAP)

Di-ammonium Phosphate (DAP) Fertilizer

Di-ammonium Phosphate is also called concentrated supper phosphate It is an important fertilizer and also manufactured in Pakistan. It is also called Complex fertilizer if we add KCL in fertilizer. It means fertilizer contains NPK nutrient. The nutrient used in fertilizer is 18% N2, 46% P2O5 and K.

Handling, Storage and Packing

- DAP usually do not create any problem in the atmosphere and it is free flowing in nature.
- Granulated DAP on the other hand can be easily handled and uniformly distributed in the field.
- **Storage** – It is stored in air conditioned silos. The packaged DAP is stored in warehouses or silos to protect it from moisture and contamination.
- **Bagging** – It is packed in multi-wall lined gunny bags (or) HDPE bags.

Global Production and Consumption Trends

Production

The global production of DAP has been steadily increasing, driven by the growing demand for food and the need to enhance agricultural productivity, particularly in developing regions.

Consumption

Demand for DAP is highest in Asia, with China and India being the largest consumers, followed by North America and Europe. The rise in global population and the need for improved crop yields are the primary drivers of DAP consumption.

Trade Flows

Major exporting countries include Morocco, the United States, and Russia, while the leading importers include India, Brazil, and Southeast Asian nations.

Factors Influencing DAP Market Dynamics

Supply and Demand

The availability of raw materials, production capacity, and changes in global agricultural practices significantly impact the supply and demand dynamics of the DAP market.

Energy Costs

The cost of energy, particularly natural gas, which is a key feedstock for DAP production, plays a crucial role in determining the overall market prices.

Geopolitical Factors

Fluctuations in global trade policies, tariffs, and political tensions can disrupt supply chains and influence the international pricing of DAP.

Environmental Regulations

Stricter environmental regulations regarding the production and use of fertilizers can impact the DAP market by altering the cost structure and availability of the product.

Pricing Trends and Outlook

Perpetual Solutions

1

Historical Prices

DAP prices have historically exhibited volatility, with significant fluctuations driven by changes in supply, demand, and global economic conditions.

2

Current Pricing

In recent years, DAP prices have remained relatively high, reflecting the impact of factors such as rising energy costs and geopolitical tensions.

3

Future Outlook

The future pricing of DAP is expected to be influenced by the continued growth in agricultural demand, the availability of raw materials, and the impact of evolving environmental regulations.

Key Players and Market Share Analysis

Top Producers

The global DAP market is dominated by a few large multinational companies, such as OCP Group, Mosaic, and PhosAgro, which account for a significant share of the total production.

Regional Dominance

While the leading producers are global in scope, the production and distribution of DAP is often regionalized, with certain companies and countries dominating specific geographic markets.

Competitive Landscape

The DAP market is characterized by intense competition, with players constantly striving to enhance their production capacity, improve operational efficiency, and expand their global market presence.

Regulatory Landscape and Environmental Considerations

Emissions Regulations

Stricter environmental regulations governing the production of DAP, such as limits on greenhouse gas emissions and water pollution, are driving manufacturers to adopt more sustainable practices.

Nutrient Stewardship

Governments and industry organizations are promoting the responsible use of DAP and other fertilizers to minimize the environmental impact of agricultural practices, such as reducing nutrient runoff.

Circular Economy

The industry is exploring ways to promote a more circular economy approach, including the development of technologies to recycle and reuse nutrients from waste streams.

Emerging Applications and Innovations

Biostimulants

The integration of DAP with biostimulants, such as microorganisms and plant extracts, to enhance plant health and productivity.

Organic Agriculture

The development of organic-certified DAP products to meet the growing demand for sustainable agricultural practices.

Precision Farming

The use of advanced technologies, such as GPS-guided application and variable-rate technologies, to optimize the use of DAP and other fertilizers.

Water-Soluble DAP

The production of water-soluble DAP formulations for use in hydroponic and fertigation systems, catering to the needs of modern farming techniques.

USES of DAP

Following are the uses of ammonium phosphate:

- It is used as quick dissolving fertilizer.
- It is used as fire retarding agent for wood, paper and clothes.
- It is used as nutrient for the growth of micro-organisms, which are used in Fermentation industry.
- (DAP) blends are used on a range of crops in broad-acre farming, cereals, sugar cane, sowing pastures, dairy pastures, fodder crops and also in horticultural crops, for example, vegetables and tree crops.

USES of DAP

:

- DAP is used as a fertilizer. When applied as plant food, it temporarily increases the soil pH, but over a long term the treated ground becomes more acidic than before upon nitrification of the ammonium. It is incompatible with alkaline chemicals because its ammonium ion is more likely to convert to ammonia in a high-pH environment.
- The average pH in solution is 7.5–8.
- DAP can be used as a fire retardant. It lowers the combustion temperature of the material.
- DAP is also used as a yeast nutrient in winemaking and mead brewing.
- as an additive in some brands of cigarettes purportedly as a nicotine enhancer.
- to prevent afterglow in matches, in purifying sugar.
- as a flux for soldering tin, copper, zinc and brass.
- to control precipitation of alkali-soluble and acid-insoluble colloidal dyes on wool.

Agricultural Applications

Crop Nutrition

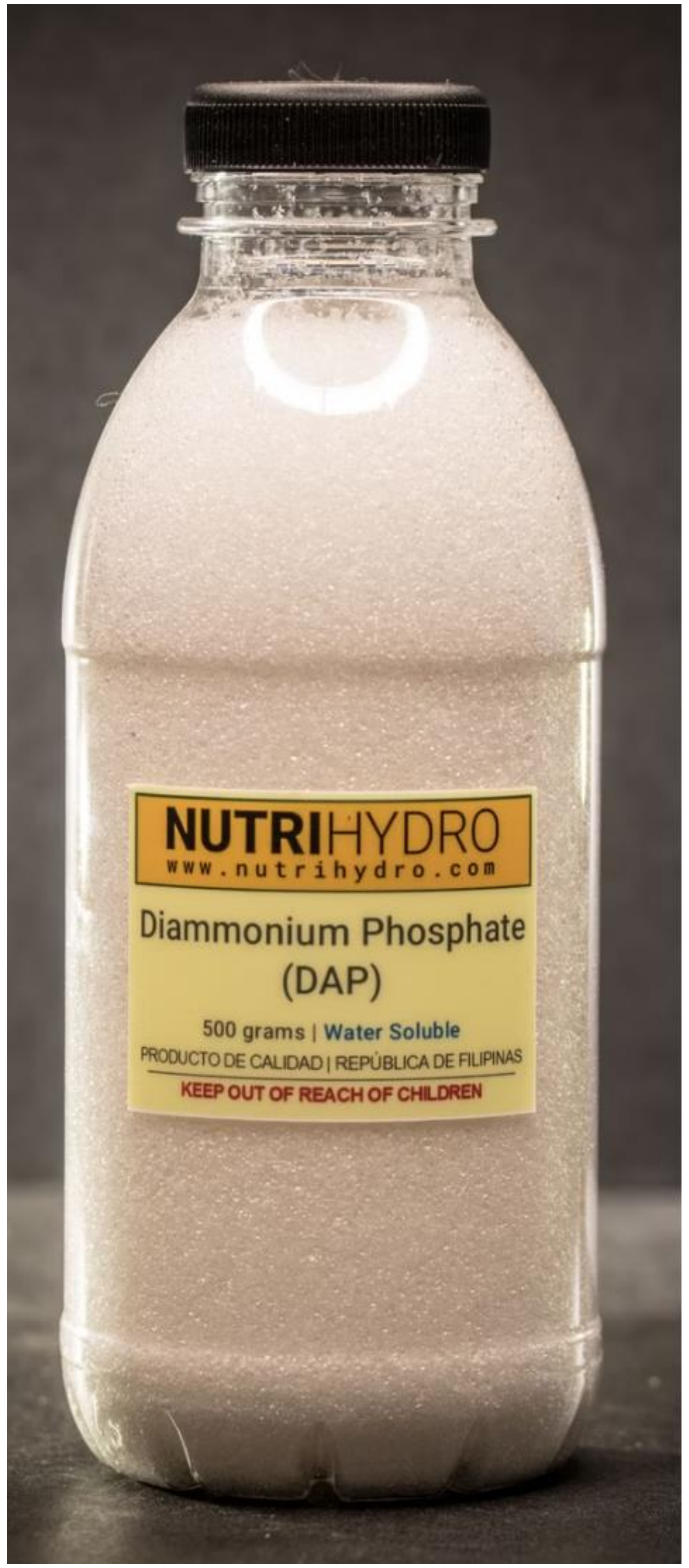
DAP is a popular fertilizer for a wide range of crops, including cereals, vegetables, and fruits, providing essential nutrients for growth and yield.

Soil Amendment

DAP can improve soil fertility by increasing soil phosphorus levels and enhancing nutrient availability for plants.

Efficiency

The high nutrient analysis of DAP makes it an efficient and economical choice for farmers, reducing the amount of fertilizer needed per acre.



Water Treatment Uses

Perpetual Solutions

Phosphate Removal

DAP can be used to remove excess phosphates from wastewater, preventing eutrophication in water bodies.

pH Adjustment

The alkaline nature of DAP can be used to adjust the pH of water, making it suitable for various industrial processes.

Coagulant

DAP can act as a coagulant, helping to remove suspended solids and impurities from water.

Industrial Applications

Flame Retardant

DAP is used as a flame retardant in various products, including textiles and construction materials.

Chemical Reagent

DAP serves as a versatile chemical reagent in the production of other compounds and materials.

Food Additive

DAP is used as a leavening agent and acidity regulator in certain food products.

Environmental Considerations

1

Nutrient Pollution

Improper use or disposal of DAP can lead to nutrient pollution, adversely affecting aquatic ecosystems.

2

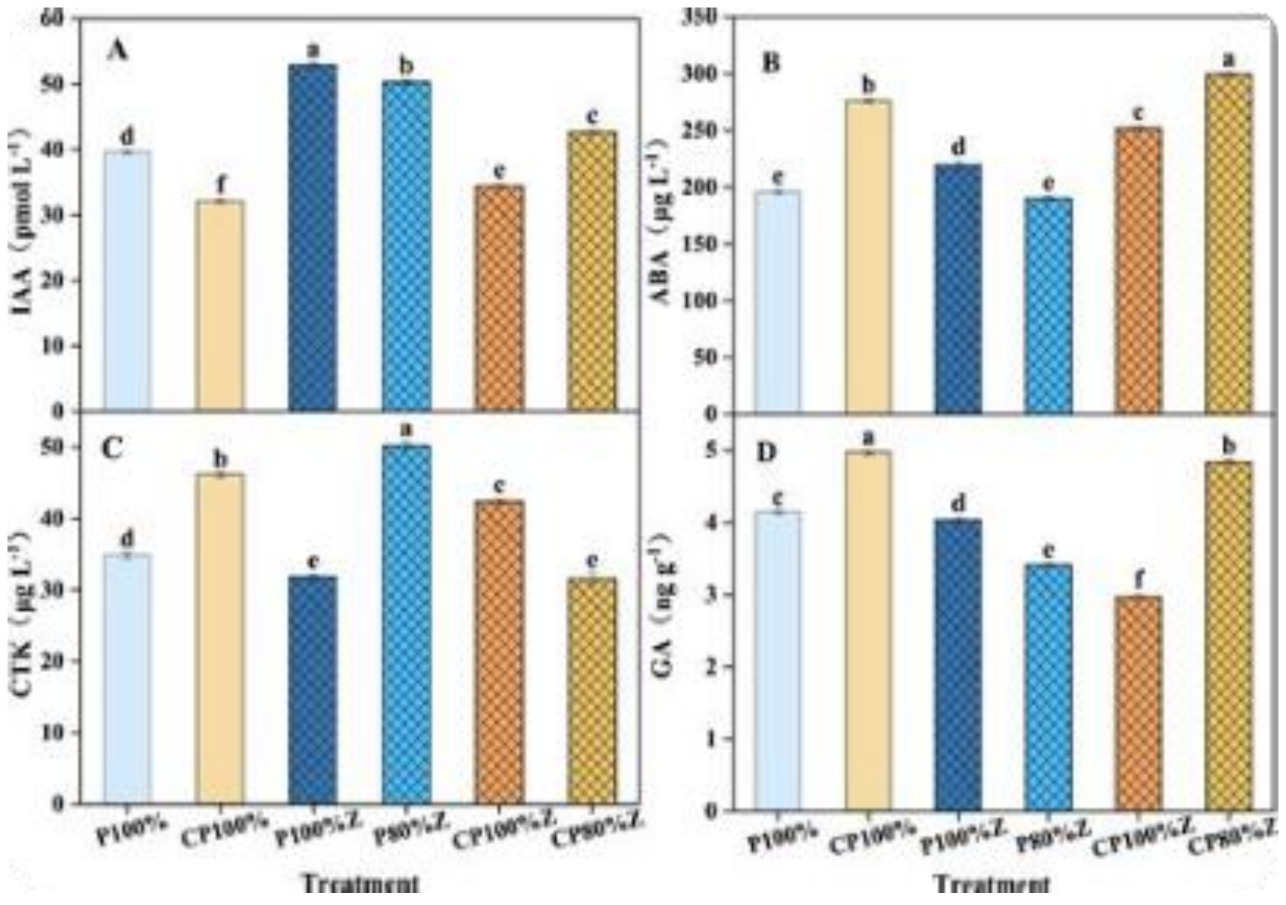
Runoff and Leaching

DAP can be susceptible to runoff and leaching, potentially contaminating soil and water sources.

3

Sustainable Practices

Careful management and responsible application of DAP are crucial to minimizing environmental impacts.



Key Takeaways

Versatile Fertilizer	DAP provides both nitrogen and phosphorus, essential nutrients for plant growth and development.
Efficient Nutrient Delivery	The high nutrient analysis of DAP makes it a cost-effective choice for farmers and growers.
Environmental Considerations	Responsible usage and disposal of DAP are crucial to mitigate potential environmental impacts.

Conclusion and Future Prospects

Diammonium Phosphate (DAP) remains a vital contributor to global food production, with its role expected to continue growing in the coming years. The production of DAP involves a complex, multi-step process that transforms raw materials into a high-quality, practical, and cost-effective fertilizer product.

However, the industry faces challenges related to environmental sustainability, supply chain dynamics, and the need for innovative solutions to enhance efficiency and reduce the environmental impact of its use.

Addressing these issues will be crucial for the long-term success and viability of the DAP market.

Perpetual
Solutions

THANK YOU