

CL 304 Presentation

AMMONIA AND DIAMMONIUM PHOSPHATE (DAP) PRODUCTION: POSSIBLE REACTION AND METHODS

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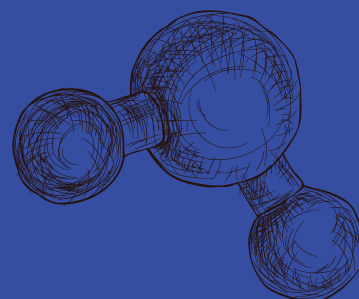
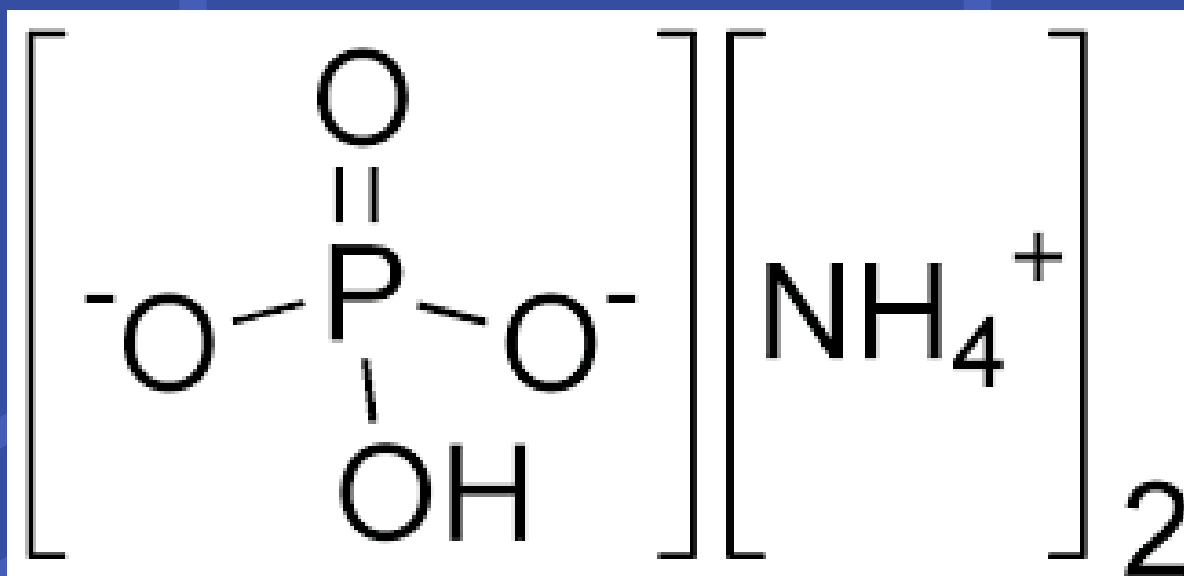
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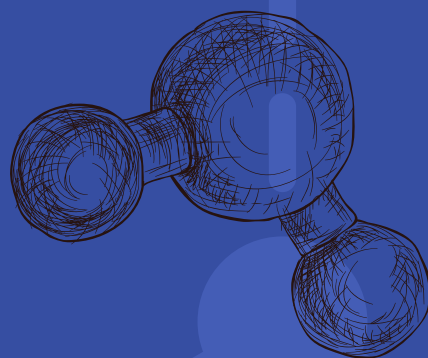
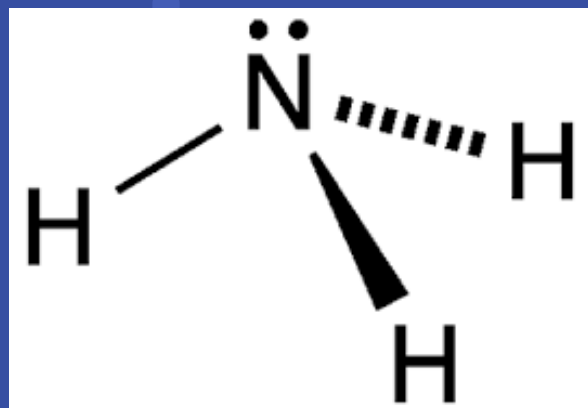
INTRODUCTION



DIAMMONIUM PHOSPHATE (DAP)

- Diammonium phosphate, commonly known as DAP is an inorganic phosphate, being the diammonium salt of phosphoric acid.
- Common used fertilizer in agriculture
- Has a high concentration of nitrogen and phosphorus, vital for plant growth.

| | |
|--------------------------|--|
| IUPAC Name | Di-ammonium hydrogen orthophosphate |
| Molecular Formula | (NH ₄) ₂ HPO ₄ |
| Molecular Weight | 132.1 |



AMMONIA(NH₃)

- It is a colourless gas with a distinctively pungent odour
- Prepared by Haber-Bosch process in which nitrogen and hydrogen gases are reacted at high pressure and temperature conditions to form ammonia



USES :

- In production of fertilizers
- In refrigerants, metal treatment, water treatment, laboratory reagents etc.

| Property | Value or Detail |
|----------------------|---------------------------|
| Molecular Mass | 17.03 g/mol |
| Colour | Colourless |
| Odour | Sharp, irritating |
| Physical State | Gas (at room temperature) |
| Melting Point | -77.7°C |
| Boiling Point | -33.35°C |
| Flash Point | 11°C |
| Decomposition Point | 500°C |
| Density (gas) | 0.7710 g/L |
| Density (liquid) | 0.6818 g/L |
| Vapour Density | 0.5697 |
| Critical Temperature | 132.4°C |
| Critical Pressure | 111.3 atm |
| Heat of Fusion | 58.1 kJ/mol |
| Heat of Vaporization | 23.3 kJ/mol |
| Heat of Combustion | -316 kJ/mol |

PROPERTIES OF DAP

NUTRIENT CONTENT

High in nitrogen (18%) and phosphorus pentoxide (46%).



WATER SOLUBILITY

Highly soluble in water for rapid nutrient uptake.



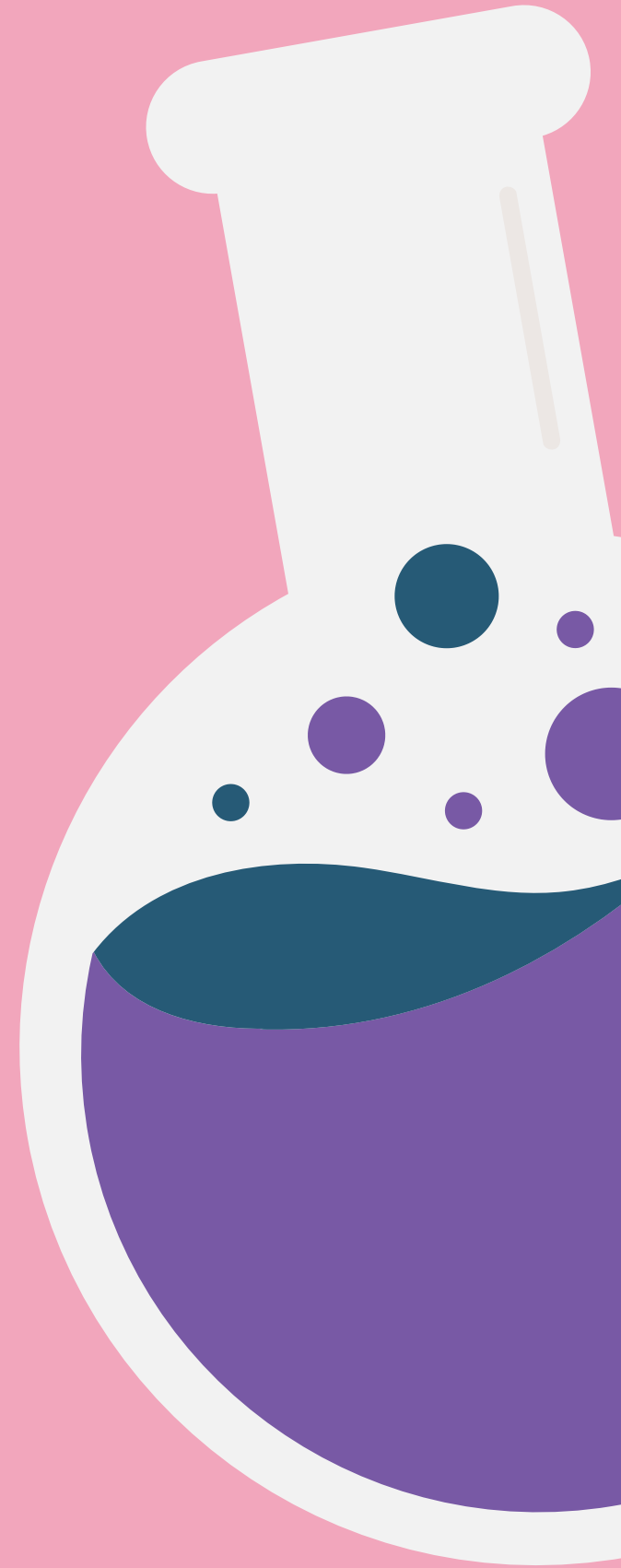
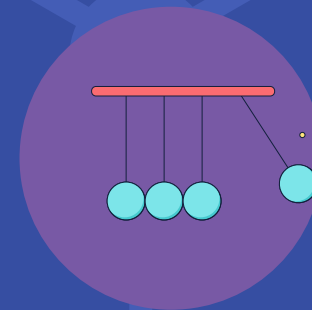
PH LEVEL

Moderately acidic, typically pH 7-8 when dissolved



STORAGE STABILITY

Relatively stable with good storage properties.



PROPERTIES OF DAP

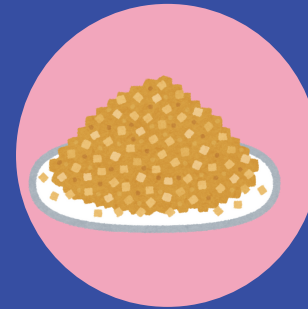
COMPATIBILITY

Compatible with most fertilizers and agricultural chemicals.



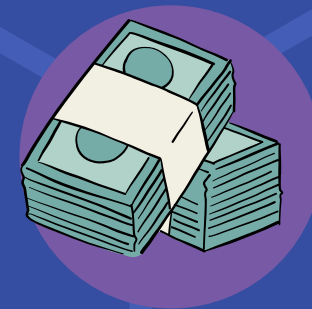
UNIFORM GRANULE SIZE

Commercially available in uniform granules for even distribution.



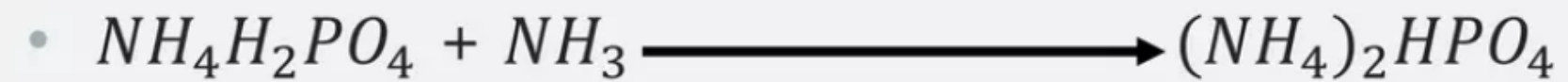
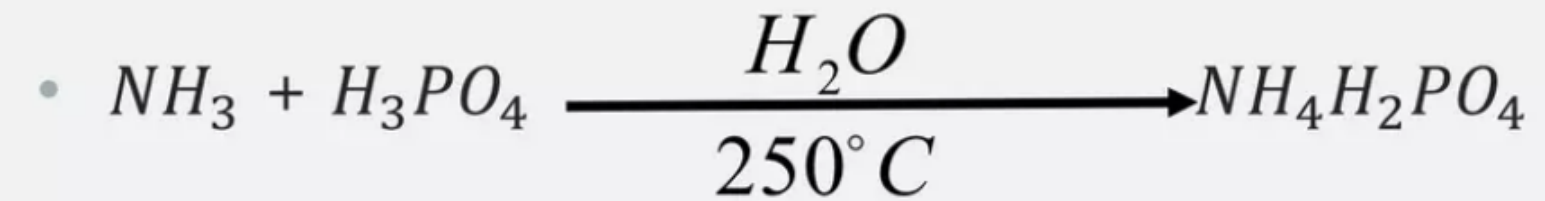
ECONOMIC VAIBILITY

Economically viable due to its high nutrient content and efficiency.



METHOD OF PREPARATION

CHEMICAL REACTIONS FOR DAP PRODUCTION

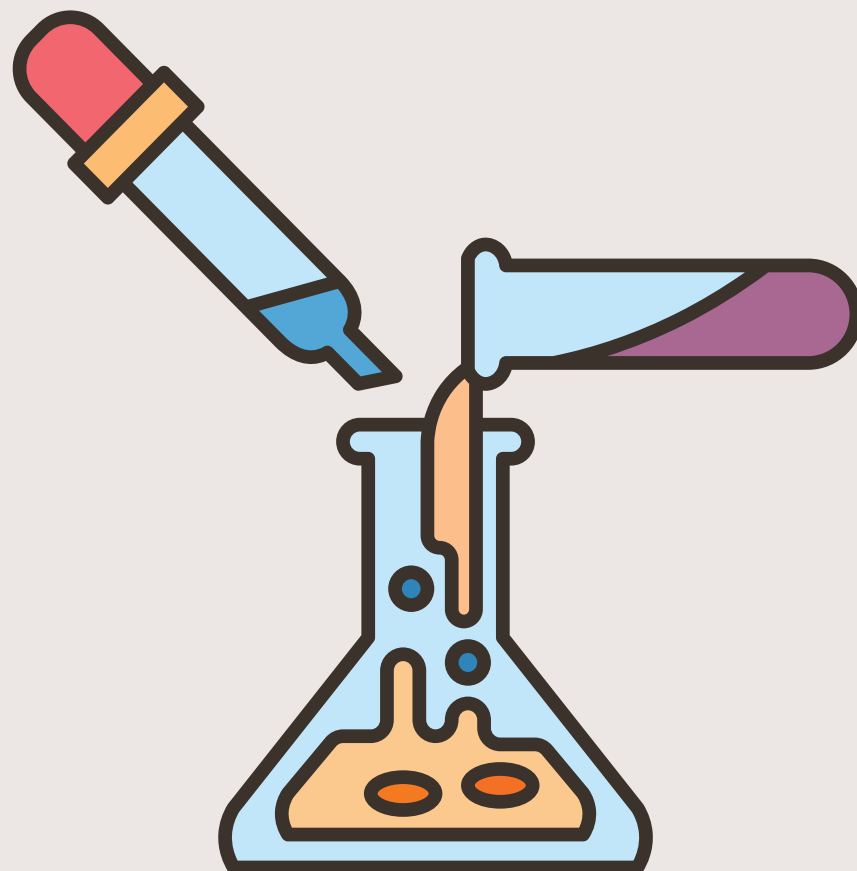


Purified DAP is made from phosphoric acid and ammonia in the following stages:

MANUFACTURING OF DAP

1. PRE-NEUTRALIZATION:

- In the first step, purified Phosphoric acid and ammonia react to each other in the presence of small amount of water.
- The introduction of ammonia aids in the removal of filterable impurities from the wet-process acid, including iron (Fe), aluminum (Al), fluorine (F), calcium (Ca), and magnesium (Mg).
- A pure solution of monoammonium phosphate($\text{NH}_4\text{H}_2\text{PO}_4$) is left behind as filtrate.
- Temperature at this stage must be controlled in between 220-250 °C.

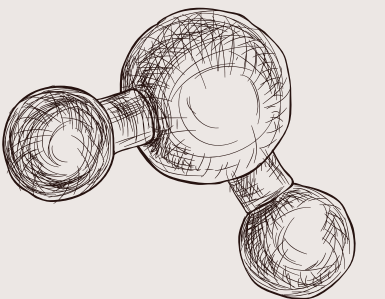
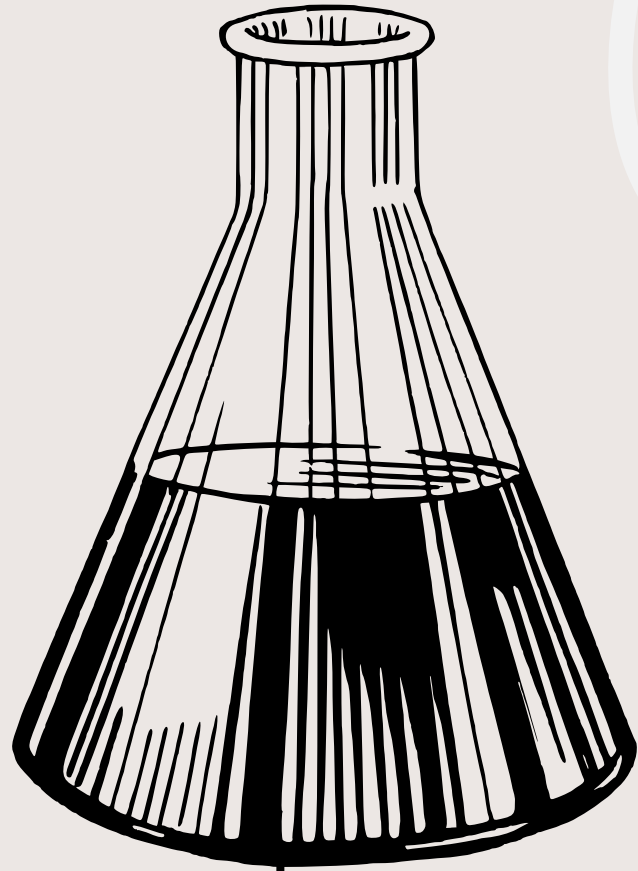


2. EVAPORATION:

The filtrate obtained from the first stage, which is practically a pure solution of monoammonium phosphate, is then subjected to evaporation. Evaporation helps concentrate the solution.

3. AMMONIA SATURATION:

- In this section, monoammonium phosphate is treated with more ammonia to form diammonium phosphate.
- This is done to achieve a specific $\text{NH}_3/\text{P}_2\text{O}_6$ mole ratio of 2 to 1. This step likely involves adding ammonia gas to the solution until the desired ratio is reached.
- This saturation process may occur in a continuous single-stage saturator.



4. CRYSTALLIZATION:

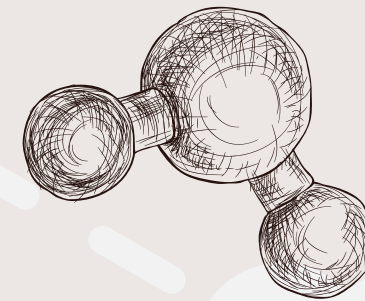
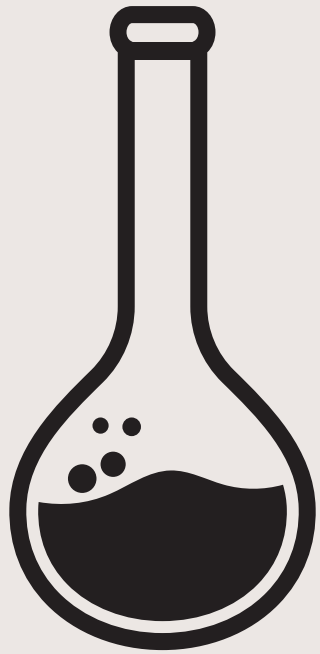
The product starts to crystallize after the ammonia in the solution is saturated. The process via which the dissolved monoammonium phosphate crystallizes is known as crystallization.

5. CENTRIFUGATION:

A centrifuge is used to separate the crystals from the residual solution after they have formed. The process of centrifugation uses centrifugal force to separate the liquid phase from the solid crystals.

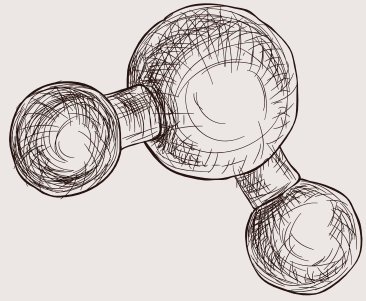
6. DRYING:

To get rid of any last traces of moisture, the separated crystals are dried with hot air.



7. 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.



8. SCREENING AND 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.

Therefore, the process of manufacturing is completed and purified diammonium phosphate is ready for sale.



FLOWSHEET

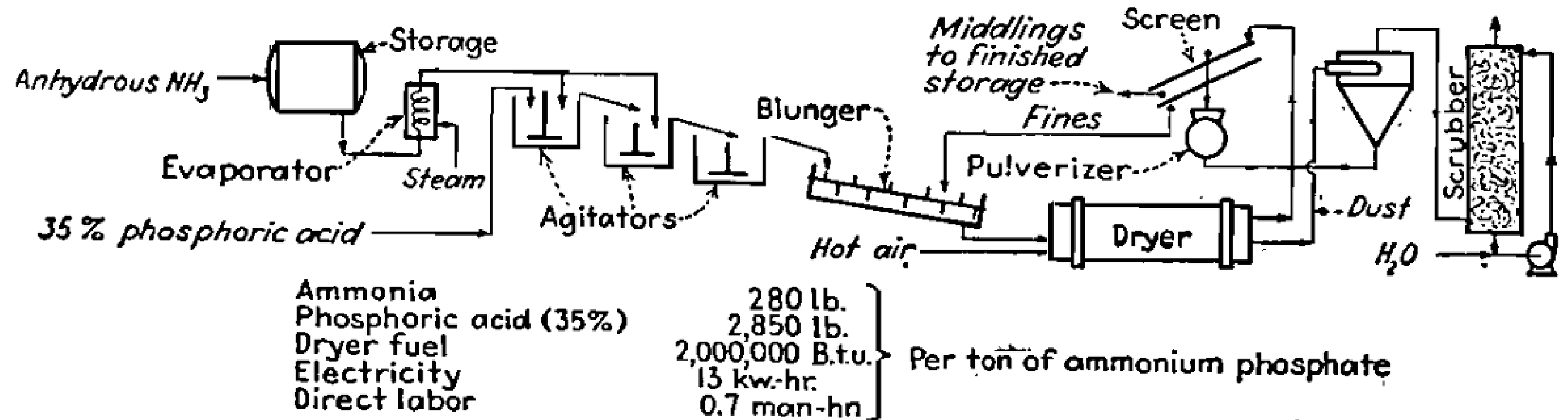
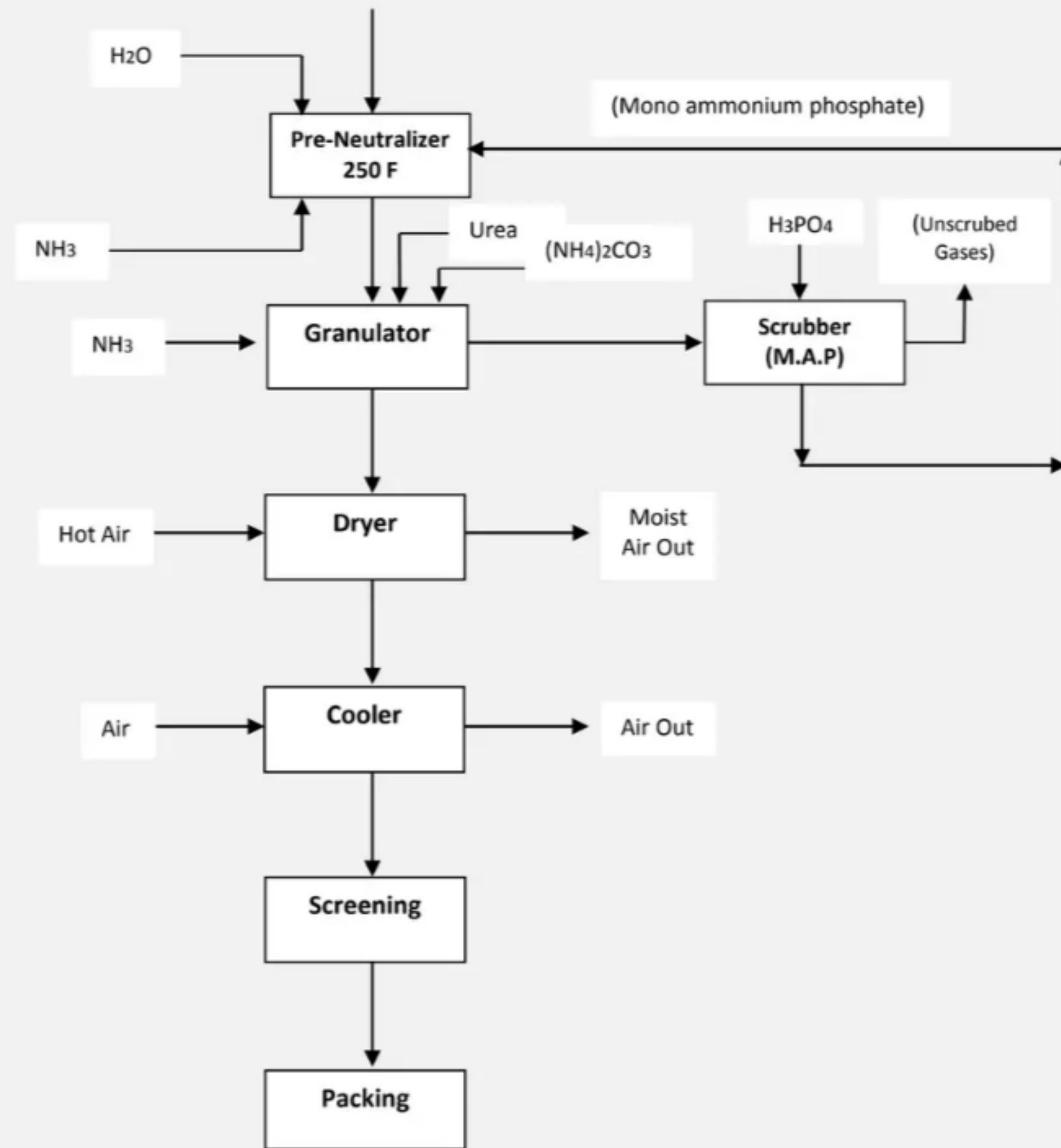


Fig. Flowsheet for DAP Production

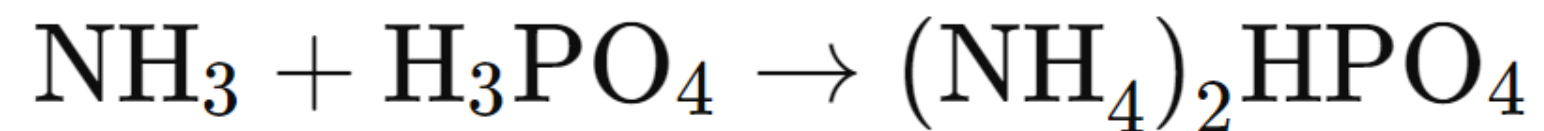




OTHER METHODS OF PREPARATION

1. NEUTRALIZATION REACTION

DAP is commonly prepared by neutralizing phosphoric acid (H_3PO_4) with anhydrous or aqueous ammonia (NH_3). This reaction forms monoammonium phosphate (MAP) initially, followed by formation of DAP as main product.



2. DORR CONTINUOUS PROCESS :

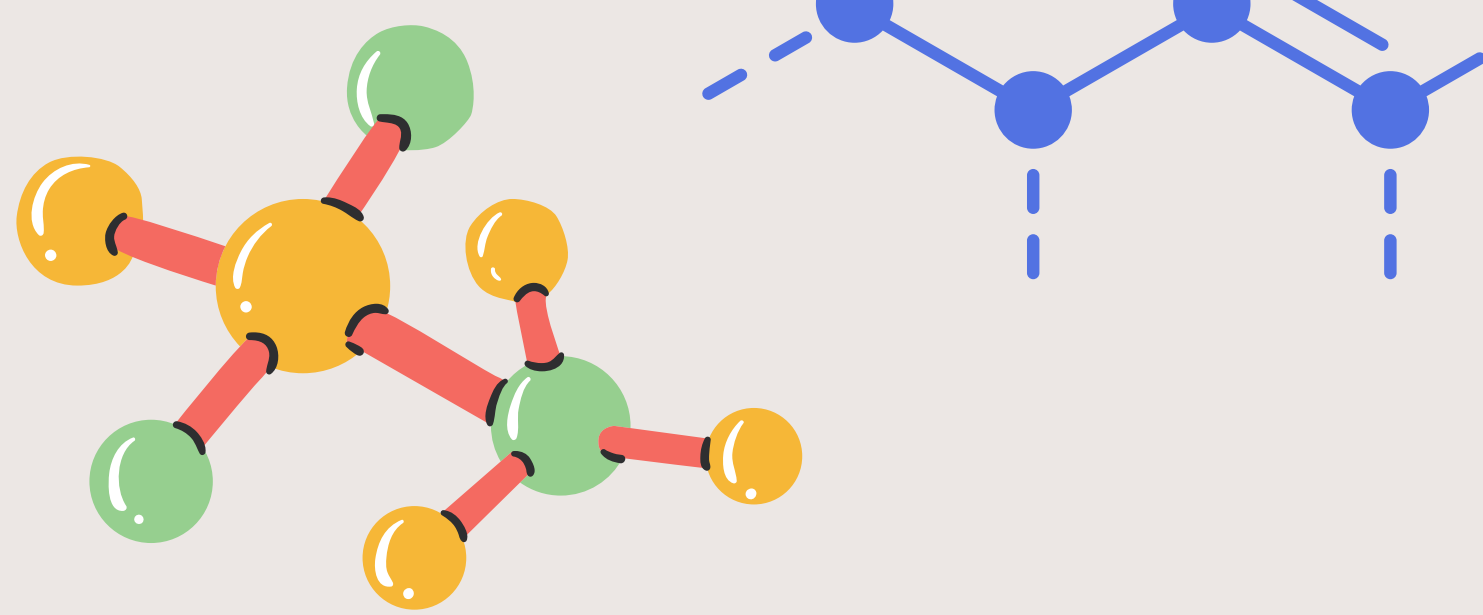
- Also known as Dorr Oliver Process, Process where phosphoric rock reacts with sulfuric acid to produce phosphoric acid.
- Phosphoric acid or a mixture of phosphoric and sulfuric acid.s can then be treated with ammonia to monoammonium or diammonium phosphate.

3. ACIDULATION

- It involves the reaction of phosphate rock with an acid, typically sulfuric acid, to produce phosphoric acid as main product and other phosphate compounds as derivatives.
- Thereby, phosphoric acid produced in the acidulation reaction is then reacted with anhydrous or aqueous ammonia (NH_3) to produce diammonium phosphate (DAP)

4. THERMAL REDUCTION

- Phosphate rock can undergo thermal reduction in an electric or blast furnace to produce phosphorus and phosphoric acid as main products.
- The phosphoric acid on further treatment with ammonia can produce DAP.

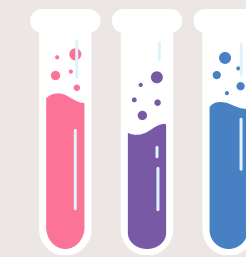


APPLICATIONS OF DAP



**USED AS QUICK
DISSOLVING
FERTILIZER**

**USED AS NUTRIENT
FOR THE GROWTH
OF MICRO-
ORGANISMS,
WHICH ARE USED
IN FERMENTATION
INDUSTRY.**



**USED AS
FLAMEPROOFING
AGENTS FOR PAPER,
WOOD, AND
TEXTILES.**

**USED AS A
COAGULANT IN
WATER TREATMENT
TO HELP CLARIFY
WATER BY CAUSING
SUSPENDED
PARTICLES TO CLUMP
TOGETHER AND
SETTLE OUT**





THANK YOU!