

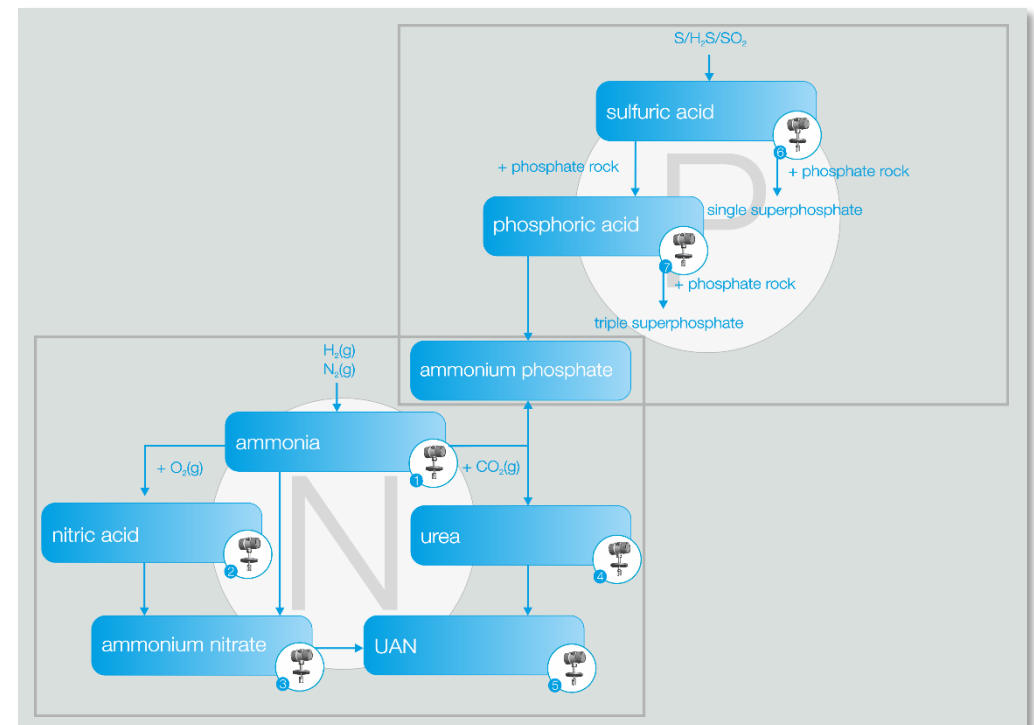


Fertilizer production

Fertilizer production

Introduction

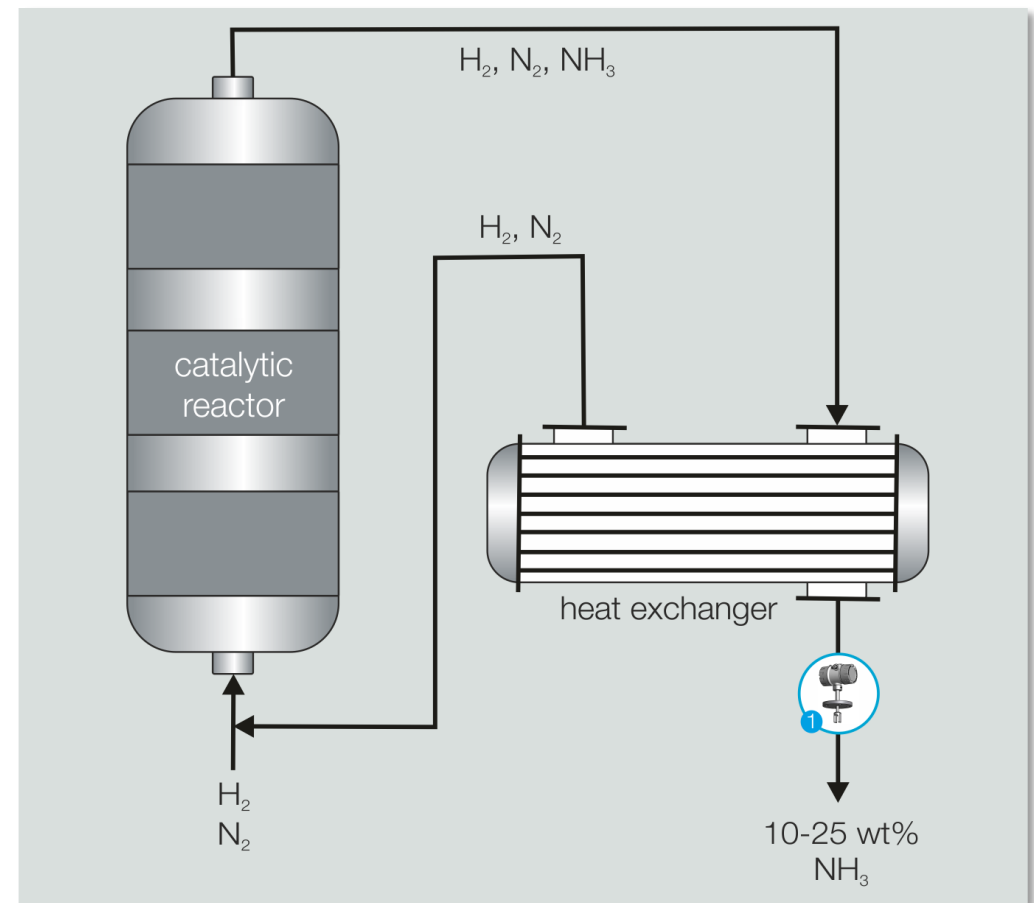
- LiquiSonic® analyzer provides advantageous utilization for the measurement of various substances, which are necessary for fertilizer production:
 - ammonia
 - nitric acid
 - ammonium nitrate
 - urea
 - urea ammonium nitrate
 - sulfuric acid
 - phosphoric acid



Fertilizer production

Ammonia synthesis

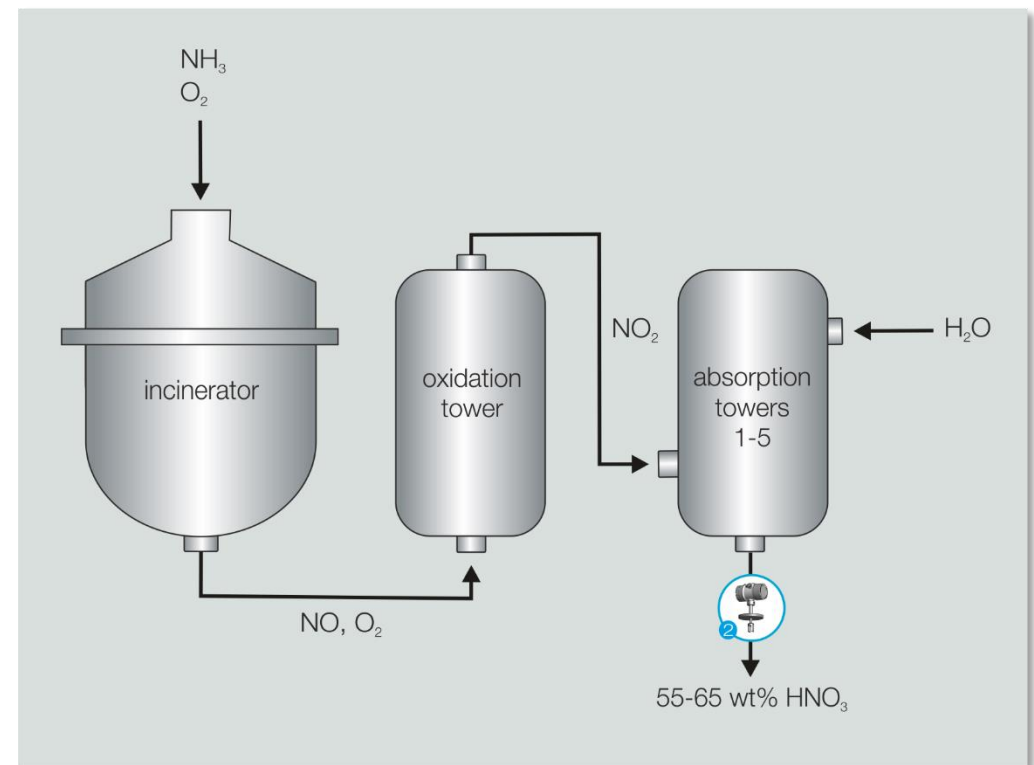
- Ammonia (NH₃):
 - key ingredient in nitrogen fertilizer production
 - activation material for the synthesis of nitric acid and urea
- industrial production by the Haber-Bosch process in three production stages:
 - [1]: gas production
 - [2]: gas purification
 - [3]: synthesis (see figure)
- synthesis: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
 - reaction is catalyzed by iron or ruthenium in a catalytic reactor
 - finally: cooling condenses ammonia
 - concentration typically ranges from 10 wt% to 25 wt%



Fertilizer production

Nitric acid synthesis

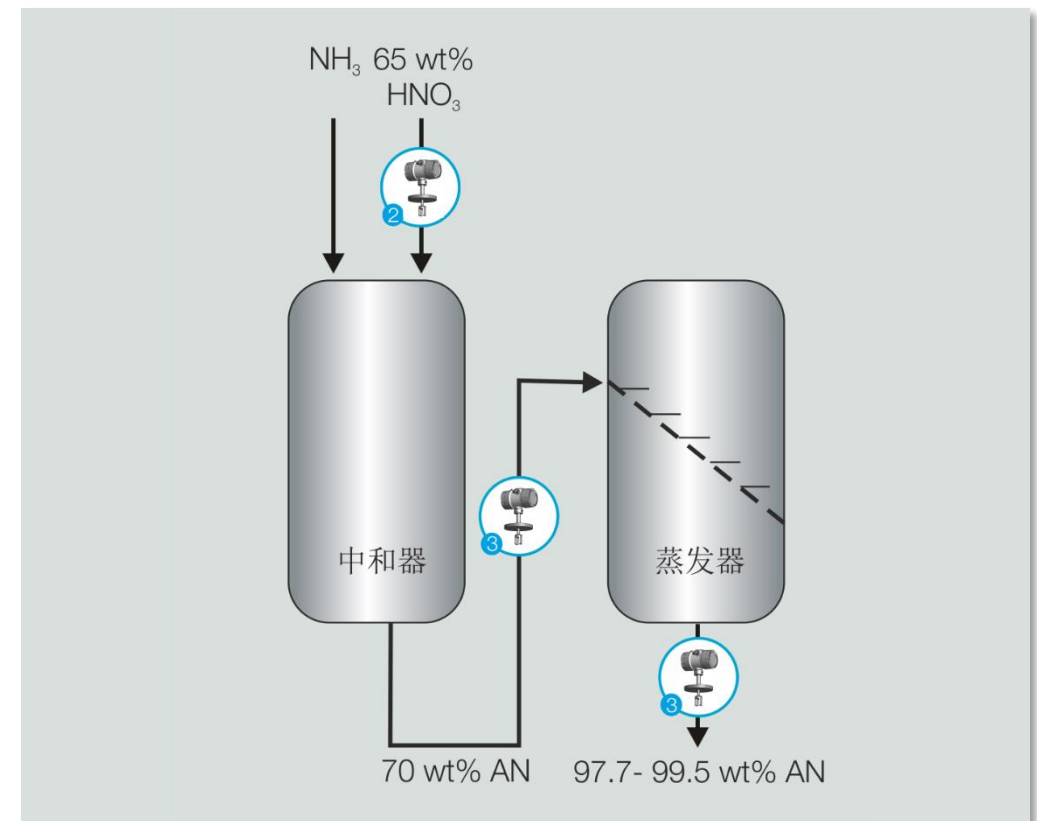
- Nitric acid (HNO_3):
 - 70 % of the HNO_3 goes toward developing fertilizer ammonium nitrate (AN)
 - rest is used for :
 - production of explosives
 - pickling of stainless steel
- Nitric acid is formed by the Ostwald process in three stages:
 - [1]: gas mixture of NH_3 and air is incinerated where NH_3 reacts on a platinum-rhodium catalytic surface to form nitric oxide (NO)
 - [2]: NO gas reacts with secondary air to prepare nitrogen dioxide (NO_2)
 - [3]: NO_2 feeds an absorption tower to engage counter-flowing water (H_2O) to yield nitric acid in typical concentrations of 55 - 65 wt% HNO_3



Fertilizer production

Ammonium nitrate production

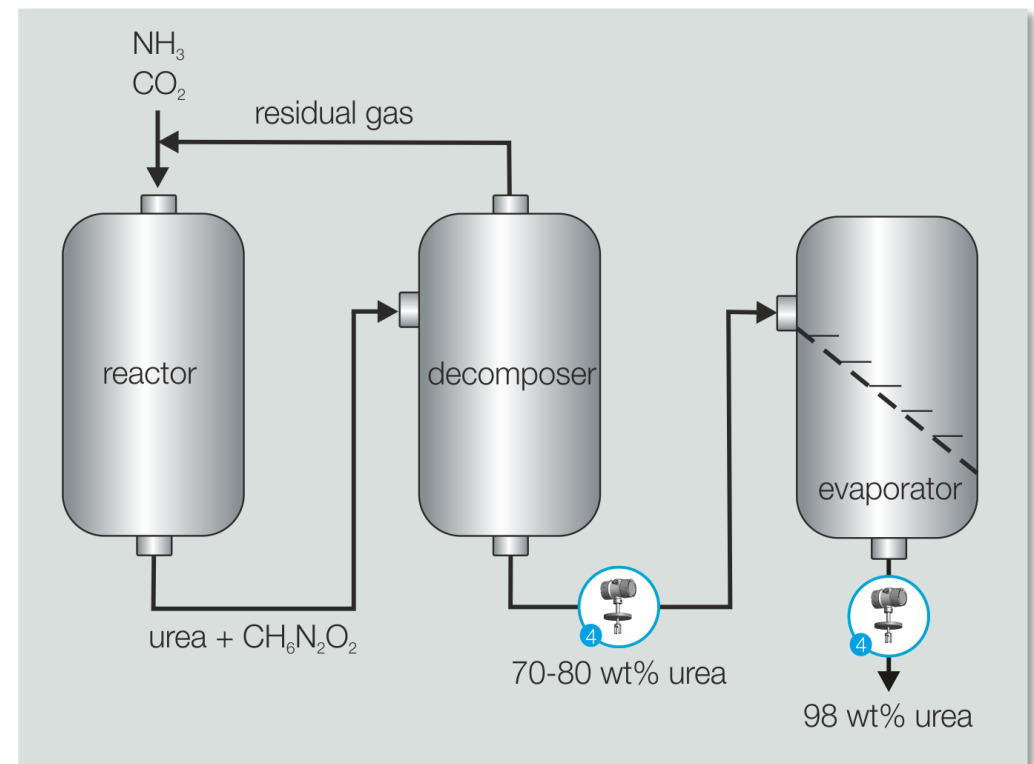
- Ammonium nitrate (NH_4NO_3) or “AN”:
 - one of the most important nitrogenous fertilizers
 - comprises 12.4 % of the world’s total nitrogen consumption
 - useful in the production of explosives
- Industrial production of ammonium nitrate:
 - almost exclusively by neutralizing NH_3 with HNO_3 to form 70 wt% AN
 - evaporation process: enhances concentration up to 99.5 wt%



Fertilizer production

Urea production

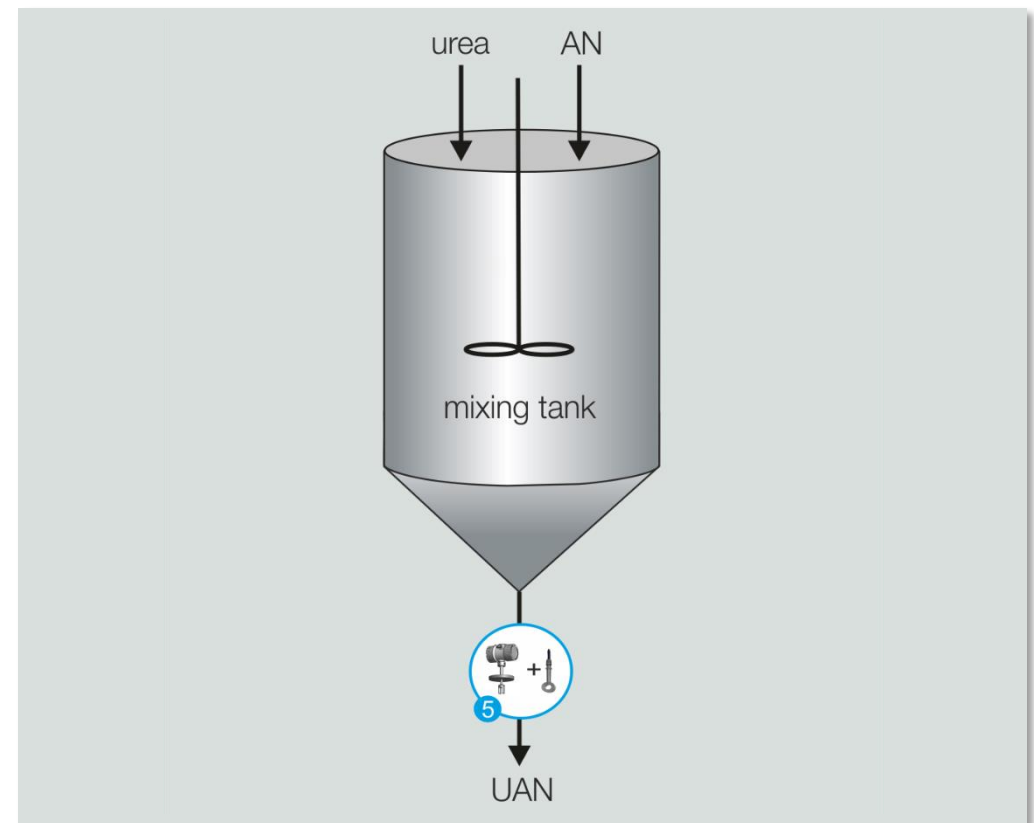
- Urea ($\text{CH}_4\text{N}_2\text{O}$):
 - high nitrogen content
 - ideal agricultural fertilizer
 - key roles in:
 - pharmacy (e.g. skin care)
 - chemistry (e.g. melamine)
- Urea production:
 - follows NH_3 formation
 - occurs in two stages:
 - [1]: NH_3 and CO_2 are heated under pressure to develop ammonium carbamate ($\text{CH}_6\text{N}_2\text{O}_2$)
 - [2]: dehydration removes H_2O to yield concentrations of 70 - 80 wt% urea
 - evaporation process: enhances concentration up to 98 wt%



Fertilizer production

Urea Ammonium Nitrate production

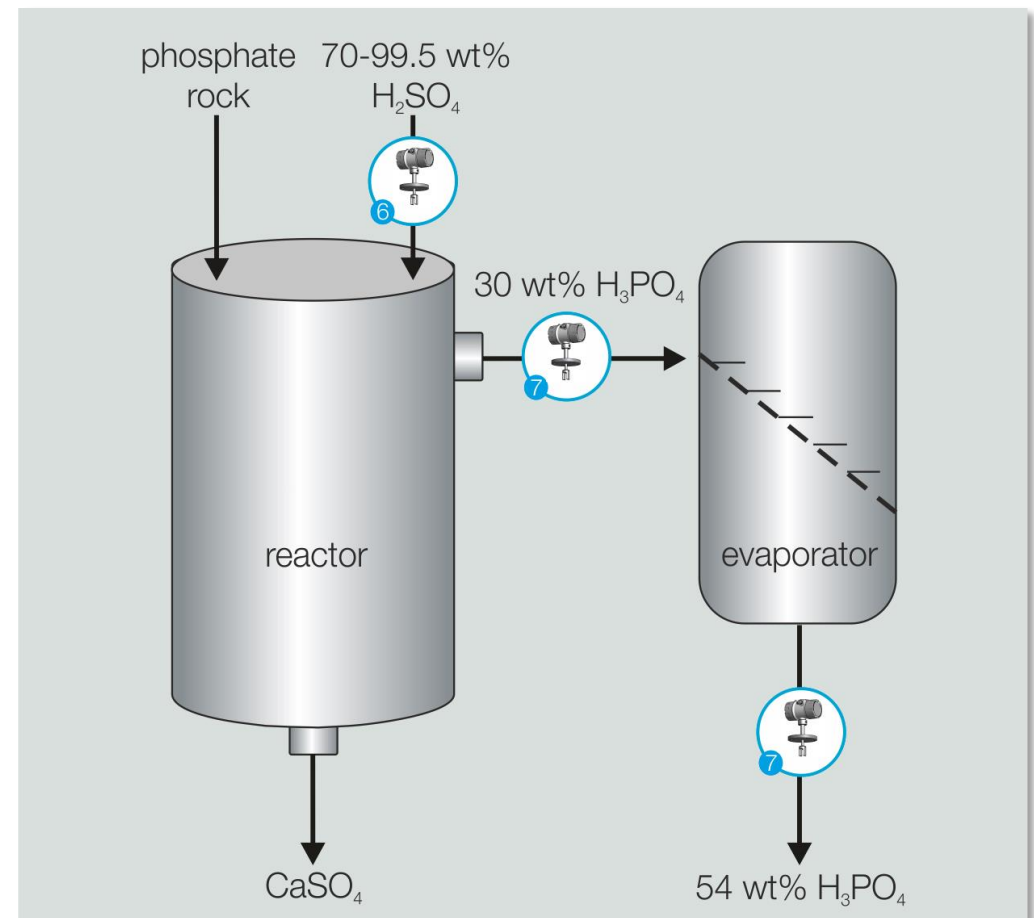
- Urea Amminoum Nitrate (UAN):
 - nitrogenous liquid fertilizer
- Industrial production:
 - UAN plants usually incorporate urea and AN production lines upstream
 - Typical recipes:
 - 40 % AN
 - 30 % urea
 - 30 % water
- LiquiSonic® analyzer measures the concentrations using a combination of sonic velocity and conductivity



Fertilizer production

Phosphoric acid production

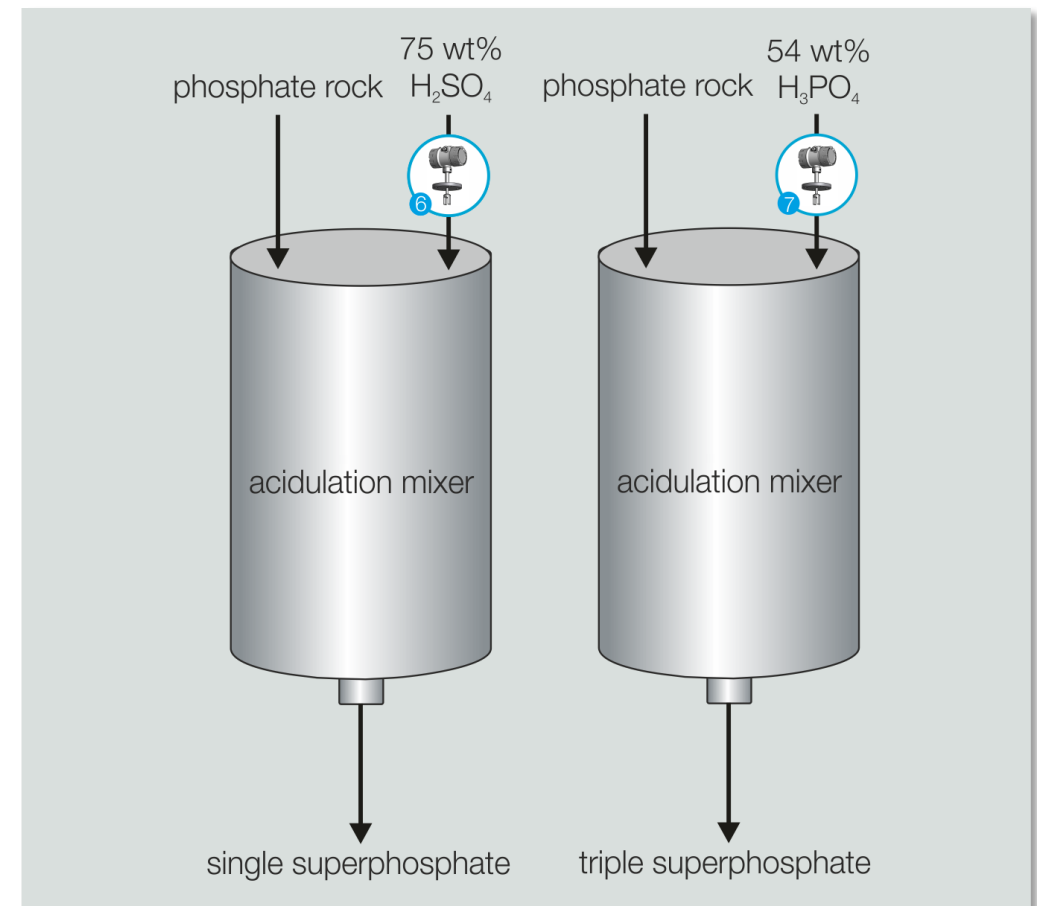
- Phosphoric acid (H_3PO_4):
 - one of the most important inorganic acids
 - necessary for the production of triple superphosphate (TSP)
- Industrial production:
 - formed by combining phosphate rock with concentrated sulfuric acid (98 wt%)
 - yield: about 30 wt% phosphoric acid
 - byproduct: calcium sulfate (CaSO_4)
 - evaporation process: enhances concentration up to 54 wt%



Fertilizer production

Superphosphate production

- Superphosphate:
 - fertilizers that vary in phosphate wt% and in secondary water-insoluble contents
- Single superphosphate (SSP):
 - formed by mixing pulverized phosphate rock with 70 - 75 wt% of H_2SO_4
 - solidified finished product contains 16 - 20 wt% phosphorus pentoxide (P_2O_5)
- Triple superphosphate (TSP):
 - prepared with phosphate rock that reacts with phosphoric acid (50 - 54 wt% P_2O_5)
 - product: solid fertilizer with 45 - 46 wt% phosphate content



Fertilizer production

Measuring ranges

Production	Input		Output	
	Material	Concentration	Material	Concentration
Ammonia	-	-	Ammonia	10-25 wt%
Nitric acid	-	-	Nitric Acid	55-65 wt%
Ammonium nitrate	Nitric Acid	55-65 wt%	Ammonium nitrate	70-99,5 wt%
Urea	-	-	Urea	70-98 wt%
UAN	-	-	Urea ammonium nitrate	30 wt% Urea 40 wt% AN
Phosphoric Acid	Sulfuric Acid	98 wt%	Phosphoric acid	30-54 wt%
SSP	Sulfuric Acid	70-75 wt%	-	-
TSP	Phosphoric Acid	54 wt%	-	-
Ammonium phosphate	Phosphoric Acid	-	Ammonium phosphate	-

Fertilizer production

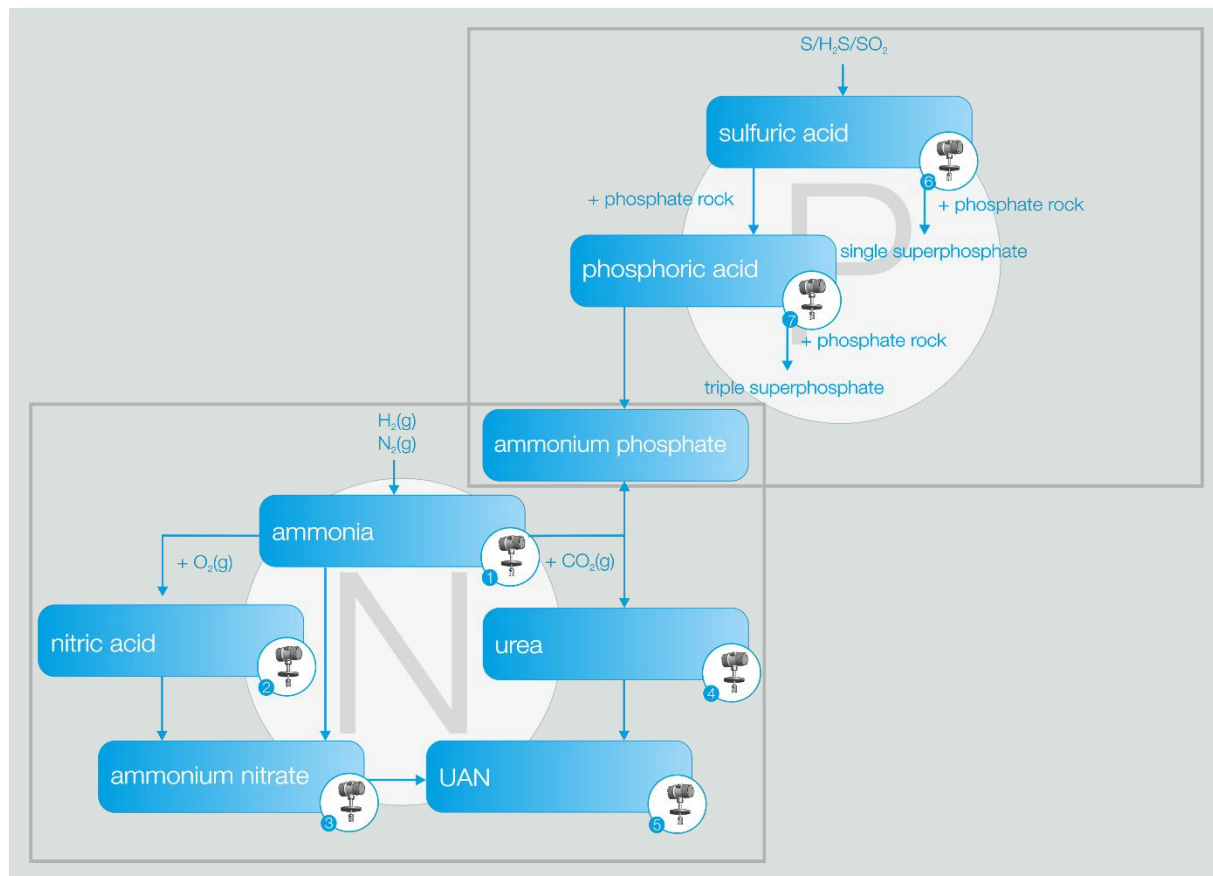
Devices

- LiquiSonic® Controller 30 V10
 - Profibus DP
 - MODBUS RTU
 - MODBUS TCP
 - analog outputs: 4 x 4-20 mA
 - digital outputs: 6x electronic relays
 - operation via touch display or browser
 - manages up to 4 sensors
- LiquiSonic® immersion sensor 40-14
 - length: customized
 - max. temperature: 120 °C (optional 200 °C)
 - process connection: DIN, ANSI
- LiquiSonic® sensor materials
 - hastelloy C2000
 - hastelloy Hybrid-BC-1
 - tantalum
 - PFA coating



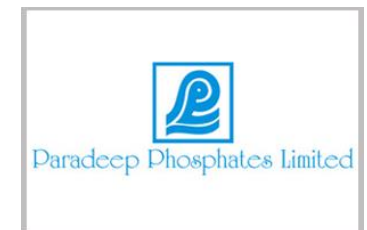
Fertilizer production

Nitrate and Phosphate process scheme



Fertilizer production

References



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In liquids, we set the measure.

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