



Phosphate Part I

<https://www.jpmmc.com.jo/Default.aspx>

Reference: Shreve's Book Ch. 10, pp. 244- 261

What is phosphate?



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- The term phosphate rock (or phosphorite) is used to denote any rock with high phosphorus content.
- Phosphate rock when very finely pulverized, has limited use of itself, because of the slow availability of P^{5-} .



Phosphate history in Jordan

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- Phosphate was discovered in Jordan in 1908 in both regions of Russaifa and Al- Hassa while laying down the Hejaz Railway. The first time investment in phosphate was in 1935 in Russaifa.

General chemistry and technology used



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- Phosphate fertilizers are produced by adding acid to ground phosphate rock.
- If sulfuric acid is used, then super- phosphate or single, phosphate (SSP) is produced having a phosphorous content of 16- 21 percent as (P_2O_5).
- If phosphoric acid is used to acidulate the phosphate rock, then triple super phosphate (TSP) is the result.
- TSP has a phosphorous content of 45- 50 percent as P_2O_5 .

Super phosphate production

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- Superphosphate, $\text{Ca}(\text{H}_2\text{PO}_4)$ is produced by combination of phosphate rock and concentrated sulfuric acid, approximately equal amounts of the two ingredients are mixed.
- Overall reaction



Super phosphate production

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- The produced superphosphate is discharged from the cone mixer to pug mill, where additional mixing takes place and the reaction starts.
- Superphosphate drops from mill to den conveyer, which has very low travel speed to allow about 1 hr to solidify.
- when the conveyer is completely filled, it is moved slowly to cutter which form thin slices of product.
- The conveyers den is totally enclosed so that fumes do not escape in the working area.
- These fumes are scrubbed by water to remove acid and fluoride before being exhausted to the atmosphere.
- Scrubber water is neutralized by passing through limestone bed where the acid and fluoride are removed.

Super phosphate production 📢

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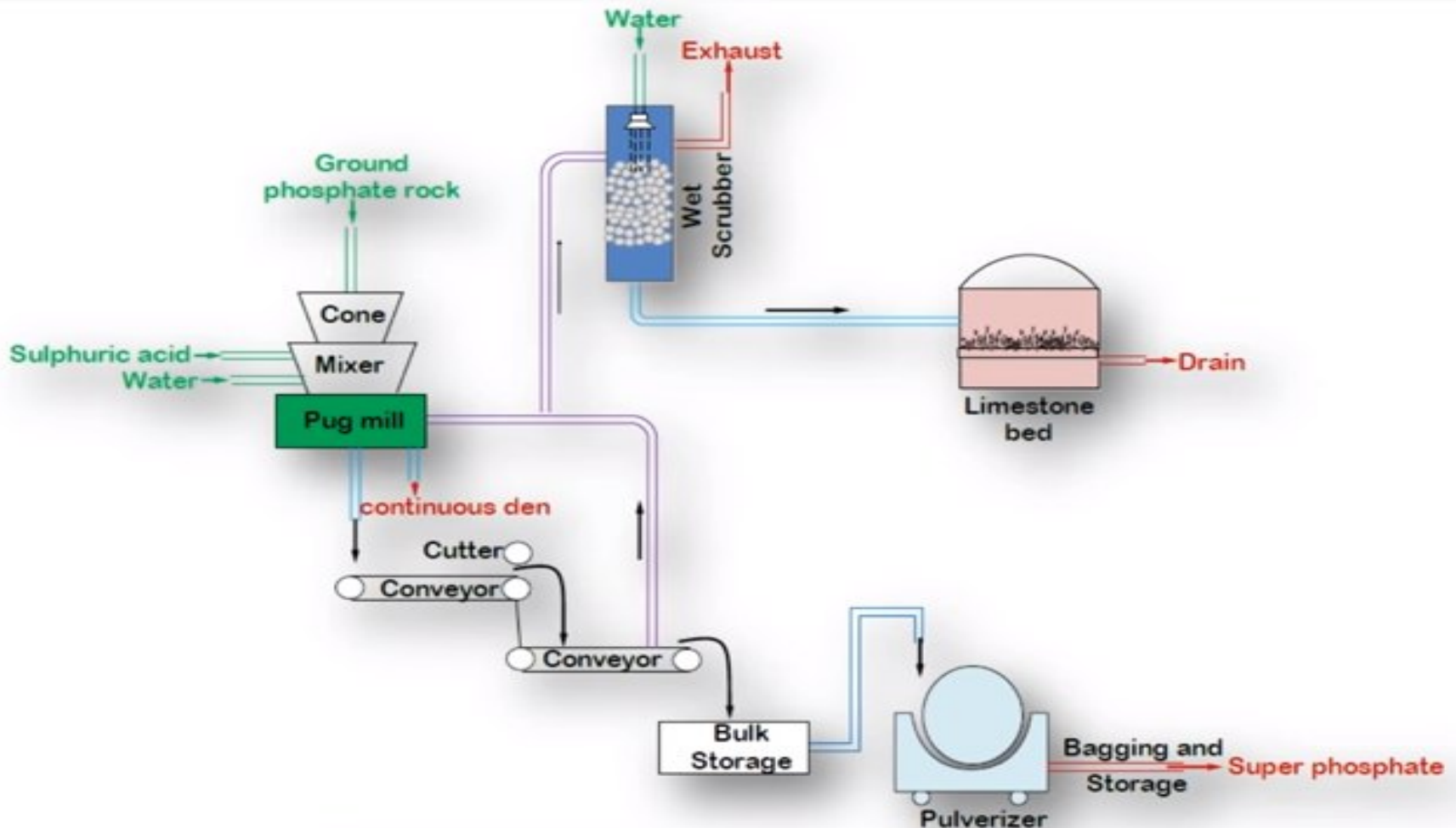


Figure: Manufacturing of Superphosphate by Continuous-den process

Triple superphosphate Production



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- Triple superphosphate (TSP) is more concentrated fertilizer than SSP, containing 45- 50 % P_2O_5 , nearly three times the amount in SSP.
- TSP is produced by adding phosphoric acid to phosphate rock producing mono calcium phosphate with no calcium sulfate.
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Triple superphosphate Production



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- 95- 98% of finely ground rock, passed through 100 mesh is mixed with H_3PO_4 .
- The mixture is fed continuously to the granulator, where reaction and granulation take place.
- The den conveyer is faster (10- 30 min) than for SSP (30- 120 min), the mixture from the reaction goes to the den where it solidifies.
- Fines from the product screen are recycled to the granulator.
- The moisture and temperature for granulation are maintained by addition of water and/or steam.

Triple superphosphate Production



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- Fumes are scrubbed by water to remove acid and fluoride before being exhausted to the atmosphere.
- The granulator is horizontal rotating cylindrical vessel.
- The granules overflow to rotary cooler, where they are cooled and dried by counter current flow of air.
- The exhaust gases from the cooler pass through the cyclone, where dust is collected and returned to the granulator.
- The cooled product is screened, the coarse material being milled and recycled along with fines to the granulator.
- The product is then conveyed to bulk storage, bagging and shipping.

Triple superphosphate Production



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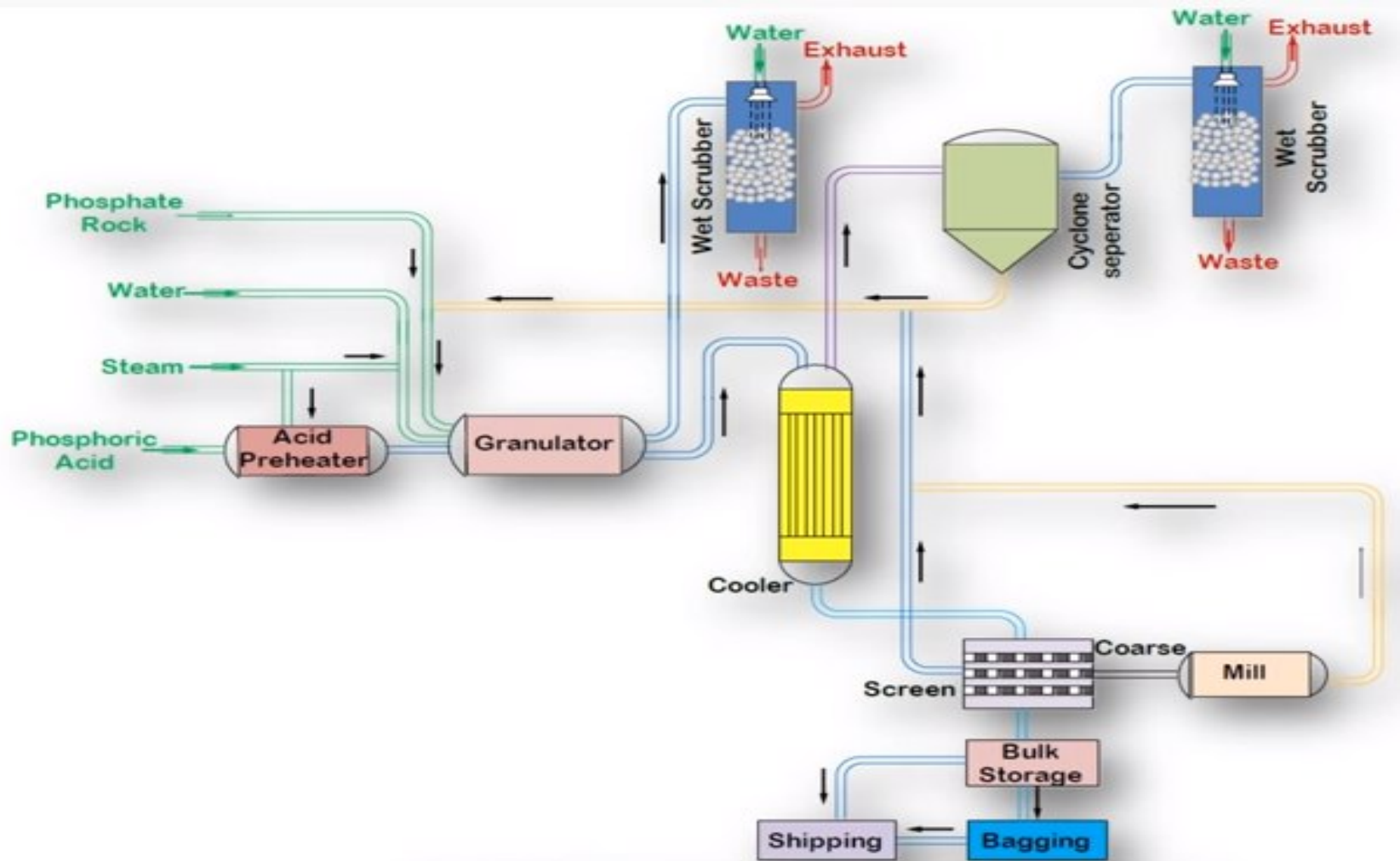


Figure: Manufacturing of Triple Superphosphate

Production of phosphate / Jordan

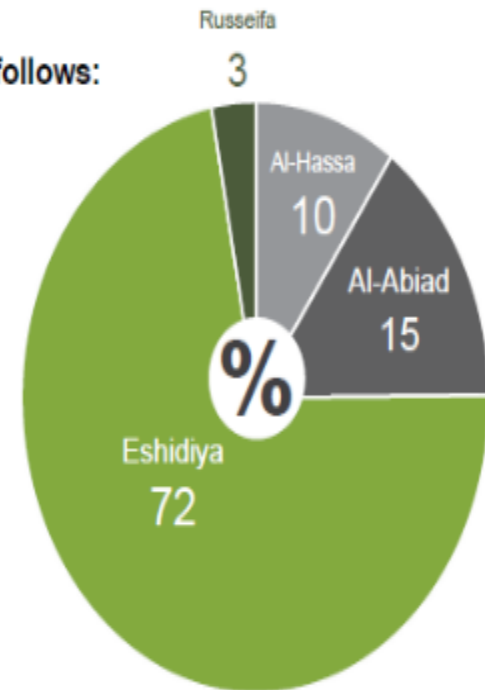


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- Production of phosphate in 2018 reached (8,022,393) tonnes; compared to (8,687,581) tonnes in 2017; a decrease of (7.7%).
- **Jordan Mines**

- The dry phosphate quantities which were produced in 2018 distributed as follows:

Mine	Production	(tonnes)
Al-Hassa	798,740	
Al-Abiad	1,204,140	
Eshidiya	5,776,948	
Russeifa	242,565	
Total	8,022,393	



Phosphate Mines



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Industrial Complex

- Is one of the largest complexes for phosphate based fertilizers in the Middle East. It is located at the Aqaba Gulf, some 18 km far from Aqaba city, and close to the Saudi- Jordanian borders.
- The Complex includes the following units:
 1. Di- Ammonium Phosphate (DAP) unit.
 2. Phosphoric Acid Unit.
 3. Sulfuric Acid Unit
 4. Aluminum Fluoride (AlF_3) Unit

Fertilizer production/Industrial complex



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- Production of the Chemical Fertilizers at Industrial Complex in Aqaba in 2018 as follows:

Product	Production	(tonnes)
DAP Fertilizer	632,400	
Phosphoric Acid	281,000	
Sulphuric Acid	856,000	
Aluminium Fluoride	6,180	

Di- Ammonium Phosphate(DAP)

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- Di- Ammonium Phosphate (DAP), as a fertilizer is produced at a capacity reaching to 3000 metric tons daily.
- It contains 18% Nitrogen, and 46% P_2O_5 , which is soluble granular, and leads to easy absorption by the plants and vegetations.
- It can be used by farms machinery, for all crops and trees, and for either rain- fed or irrigated lands.

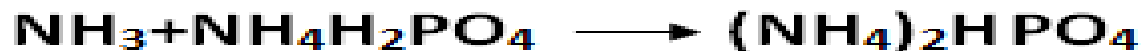
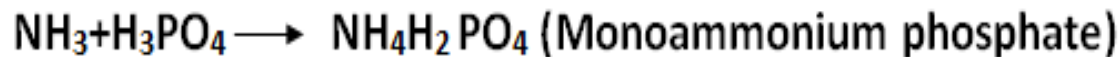
DAP production



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Production

- Ammonia is imported from several Arab and foreign countries by ships.
- pumped through a 14 inch pipe to two storage tanks.
- Temperature inside the tanks is kept around (- 33) °C , 1 atm, using special compressors.
- Ammonia is pumped to a reactor, where it reacts with concentrated phosphoric acid to produce slurry, which is pumped to a fertilizer granulator.



DAP production



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- Additional ammonia is added to the granulator to reach the required mixtures.
- Fertilizer is then moved to a rotary dryer, which is dries the fertilizer by hot gases produced by burning fuel oil, so its moisture content doesn't exceed 1.5%.
- The fertilizer is conveyed to sieves to get the required size, and then cooled down in a machine similar to the dryer, and moved to the storage silos.

Usages:

- The fertilizer is used either directly or as an input to produce other fertilizers such as liquid and suspended compound fertilizers.

DAP production



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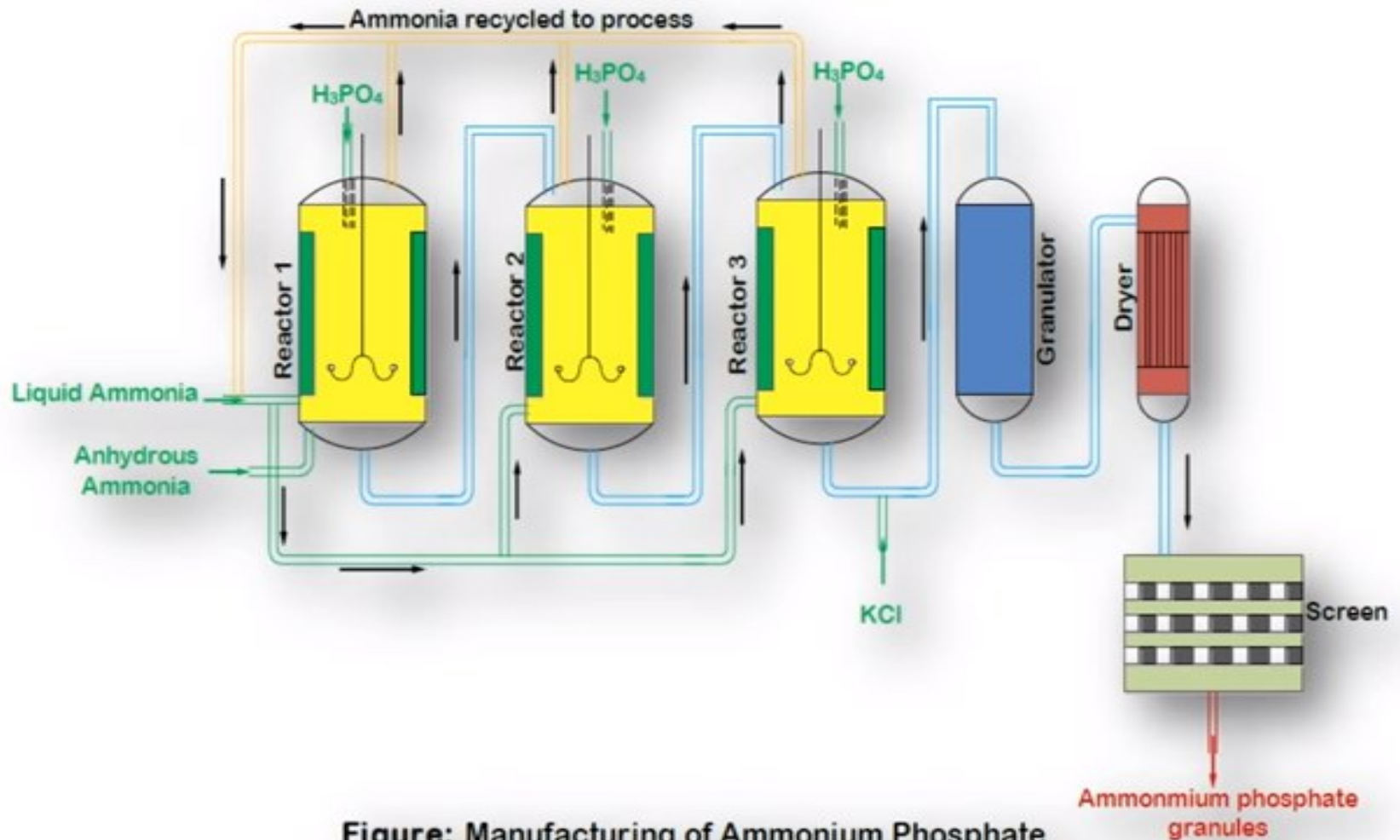


Figure: Manufacturing of Ammonium Phosphate

Environmental Hazards of DAP Production



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- The gaseous emissions from the reactor and granulator are absorbed in the gas scrubber.
- The dust from the drier, the screens and the product cooler is recovered by cyclones.