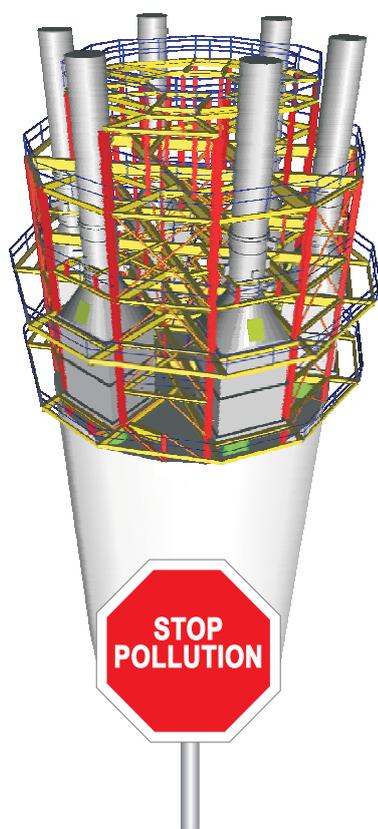


PROZAP  
for Environment

# Prilling Tower/Granulator Emission Control Unit



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## Prilling Tower/Granulator Emission Control Unit

### Wet process of dust and ammonia removal

from prilling tower and granulation units off-gases is:

- ◆ highly efficient
- ◆ reliable and trouble-free
- ◆ environment-friendly

and cleaning process products are obtained as liquids, solids and crystals

### 1. PROCESS CHARACTERISTIC:

- ◆ wet system using single- or two-stage scrubbers, demister and special spray nozzles
- ◆ useful generally in removal of diverse type dusts soluble in water or aqueous solutions, from exit gas streams as well as dusts originating from thermal processes e.g. evaporation
- ◆ low gas handling energy demand; scrubber pressure drop is approx. 800 Pa
- ◆ low utilities demand
- ◆ removal efficiency: over 90% for particles bigger than 0.7  $\mu\text{m}$
- ◆  $\text{NH}_3$  removal from exhaust gases, with efficiency over 90%
- ◆ very high operational reliability

### 2. PROCESS DESCRIPTION

#### 2.1. UREA PRILLING TOWERS AND GRANULATORS EXIT AIR CLEANING

The process is of a wet type .

Each scrubber has two circulating/spraying loops.

In one of them there is a circulation of urea solution (U) or urea/ammonium sulphate aqueous solution (UAS) or urea/ammonium nitrate aqueous solution (UAN) depending on the type of acid used to react with ammonia.

The second loop contains process water used to constant flushing of demisters and dilution of obtained product up to the required concentration.

To remove ammonia, in most cases, sulphuric or nitric acid is used depending on their availability as well as possibility of product distribution/utilization.

#### The cleaning process products - Prilling towers:

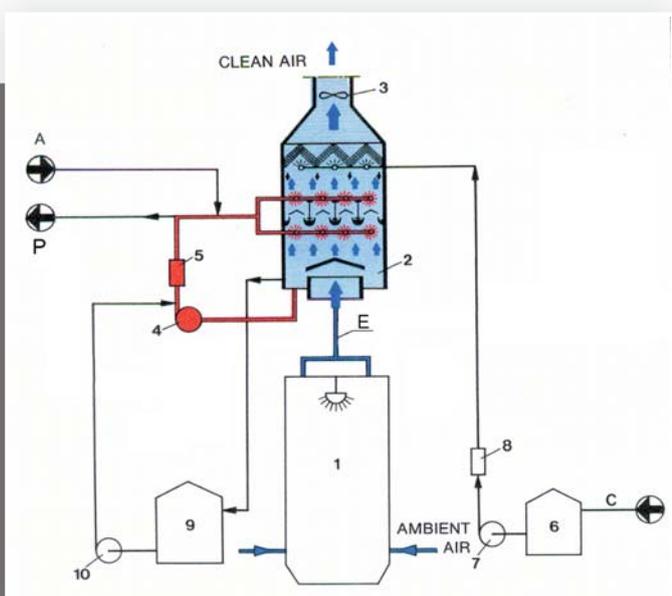
- ◆ aqueous solution of urea, concentrated up to 25% wt.
- ◆ aqueous solution of urea and ammonium sulphate (UAS) or urea and ammonium nitrate (UAN) with up to 25% wt. concentration of those components.

#### The cleaning process products - Granulators and granulator coolers:

- ◆ aqueous solution of urea concentrated up to 45% wt.
- ◆ aqueous solution of urea and ammonium sulphate (UAS) or urea and ammonium nitrate (UAN) with up to 45% concentration of those components.

#### The cleaned air contains:

- ◆ approx. 25 mg/ $\text{Nm}^3$  of dust
- ◆ approx. 25 mg/ $\text{Nm}^3$  of ammonia



Simplified process flow diagram

#### LEGEND:

- 1 - Prilling Tower/Granulator
- 2 - Scrubber
- 3 - Exhaust Fan
- 4 - Recycle Pump
- 5 - Filter
- 6 - Condensate Tank
- 7 - Condensate Pump
- 8 - Filter
- 9 - Scrubber Emptying Tank
- 10 - Start-up Pump
- A - Additives (Acid for  $\text{NH}_3$  removal)
- C - Condensate/Process Water
- E - Exhaust Gases
- P - Product

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Single- or two-stage scrubbers are used for the cleaning process.

Single-stage scrubbers are used in case of:

- ◆ simultaneous removal of dust and ammonia,
- ◆ removal of one component, i.e. urea dust or ammonia.

Two-stage scrubbers are used in case of separate removal of urea dust and ammonia, i.e.:

- ◆ first stage is used for urea dust removal and the product is a urea solution,
- ◆ second stage is used for ammonia removal and the product is a solution of ammonium sulphate or ammonium nitrate.

### 2.2. AMMONIUM NITRATE PRILLING TOWER EXIT AIR CLEANING

A wet process with application of single-stage scrubbers with demister and special spray nozzles is used.

There is a possibility to remove only ammonium nitrate dust or to remove the dust and ammonia simultaneously.

To react with ammonia some amount of nitric acid is added to the scrubbers spraying liquid. The cleaning process product is aqueous solution of ammonium nitrate.

#### The cleaned air contents:

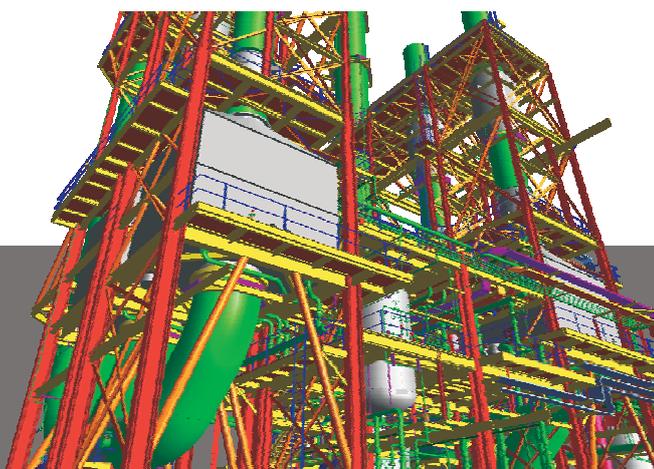
- ◆ approx. 25 mg/Nm<sup>3</sup> of dust
- ◆ approx. 25 mg/Nm<sup>3</sup> of ammonia

### 2.3. DESULPHURISATION OF GASES FROM SULPHURIC ACID PLANT OR FLUE GASES CONTAINING SO<sub>2</sub>, SO<sub>3</sub> AND H<sub>2</sub>SO<sub>4</sub> VAPOURS AND MISTS

As in the above case, single-stage scrubbers are applied in this process. To combine SO<sub>2</sub>, SO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> to the circulation loop ammonia or ammonia water is added.

The content of sulphur compounds in off-gases (calculated as SO<sub>2</sub>) is 20-30 mg/Nm<sup>3</sup>.

The cleaning process product is ammonium sulphate solution concentrated up to 35% wt.



### 3. REFERENCES

Projects cover emission control in urea, ammonium nitrate and diammonium phosphate plants.

Scrubbers are applied in wide range of plant equipment comprising prill towers, granulators, reactors, neutralizers, evaporators and concentrators.

#### Urea Prill Towers and Granulators

- ◆ Taiwan Fertilizer Company, Miaoli, Taiwan
- ◆ Ruwais Fertilizer, Abu Dhabi, U.A.E.
- ◆ Chemie-Linz, Linz, Austria
- ◆ Terra International, Sioux City, Iowa
- ◆ Borden Chemical, Geismar, Louisiana
- ◆ Z.A. "Pulawy", Poland
- ◆ SOIDC, Beiji, Iraq
- ◆ Enichem, Ferrara, Italy (Urea Granulator)
- ◆ Southern Fertilizer and Chemical, Jebel Ali, U.A.E.
- ◆ SABIC, Saudi Arabia
- ◆ Toyo Urea Plant



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### 4. POSSIBILITIES OF CLEANING PROCESS PRODUCTS USAGE/UTILIZATION

#### 4.1. Cleaning of gases from UREA PLANT

- 4.1.1. aqueous solution of urea (U)
- 4.1.2. aqueous solution of urea and ammonium sulphate (UAS)
- 4.1.3. aqueous solution of urea and ammonium nitrate (UAN)
- 4.1.4. aqueous solution of ammonium sulphate (AS).

#### 4.2. Cleaning of gases from ammonium nitrate production (AN)

- 4.2.1. aqueous solution of ammonium nitrate.

#### 4.3. In case of desulphurization

- 4.3.1. aqueous solution of ammonium sulphate (AS).

Possibilities for utilization of the above mentioned products:

- ◆ the products mentioned in paragraphs 4.1.1. and 4.2.1. above are returned to the urea and/or ammonium nitrate production process
- ◆ the product as per 4.1.2. above can be returned to the urea production. There are known examples of adding ammonium sulphate to urea (prior to granulation).  
It can be also processes (after concentration and crystallization) into a solid fertilizer being a mixture of urea and ammonium sulphate
- ◆ the product as per 4.1.3. above is a traded product and it can be sold as a liquid fertilizer
- ◆ the products/solutions as per 4.1.2., 4.1.4. and 4.3.1. can be directed to:
  - urea granulation after pre-concentration
  - crystalline ammonium sulphate production unit
- ◆ all the products mentioned above in paragraphs 4.1, 4.2. and 4.3. can be used as liquid fertilizers or as components for the production of liquid fertilizers

#### 4.4. PROCESSING OF POST-GAS CLEANING SOLUTIONS INTO CRYSTALLINE FERTILIZERS

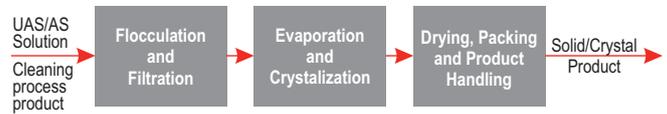
The solutions obtained after urea granulation exit gases cleaning are:

- ◆ urea and ammonium sulphate solution (p. 4.1.2. above),
- ◆ ammonium sulphate solution (p. 4.1.4. and 4.3.1. above)

can be processed into crystalline fertilizer containing:

- ◆ mixture of urea and ammonium sulphate in the amount depending on urea dust and ammonia content in gases,
- ◆ crystalline ammonium sulphate

The applied process is the property of GEA Messo Duisburg, Germany



Crystallization UNIT is based on multi-year experience of GEA Messo in investigation, development, design, supply and start-up of production units for crystalline ammonium sulphate and other chemicals.

The Crystallization UNIT characteristic features:

- ◆ flexible loading within the range of 50-110% of nom. capacity
- ◆ possibility of continuous and periodic operation
- ◆ low utilities consumption
- ◆ reliable and trouble-free operation

