The Uhde Pugmill Granulation

The Process for Safe and Reliable Production of CAN and other AN Based Fertilisers

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Agenda

- Safety considerations in AN and CAN production
- The effect of limestone/dolomite on CAN safety
- Common AN/CAN Granulation Processes
- The Uhde Pugmill Granulation Process
- Further Improvement of the Uhde Pugmill Granulation
- Conclusion
Why should we produce CAN?

- AN as fertiliser has practically more or less been banned due to strict transport and storage regulations (in the EU and USA)
- Ammonium nitrate fertilisers with ≤ 80% AN (=28%N) are considered to be safe by EU regulations (Class C fertiliser)
- The limestone/dolomite adjusts the pH value in the fertiliser and the soil (useful in many though not all soil types)
- CAN typically has better physical properties (e.g. hardness of granules)

Safety Considerations in AN and CAN Production

Decomposition of Ammonium Nitrate

by

- high temperature
- contamination
- (heating under) confinement

- chlorides
- metal ions (e.g. Cu, Zn, Cr)
- organic (combustible) carbon
- nitric acid (pH)

- feedstock
- granulation additives
- recycle of offspecs
- self-acidification
The Effect of Limestone/Dolomite on CAN Safety

The Stabilising Effect of Limestone/Dolomite

The different kinds of limestone consist to almost 100% of
- Calcium carbonate $\text{CaCO}_3$ and
- Magnesium carbonate $\text{MgCO}_3$

The stabilising effect results from the following reactions:
- $2 \text{HNO}_3 + \text{CaCO}_3 \Rightarrow \text{Ca(NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$
- $2 \text{HNO}_3 + \text{MgCO}_3 \Rightarrow \text{Mg(NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$

Reactivity of Limestone/Dolomite

Reactivity is the measure, how much of the carbonates is converted into their nitrates:
$\text{CaCO}_3 \Rightarrow \text{Ca(NO}_3)_2$ and $\text{MgCO}_3 \Rightarrow \text{Mg(NO}_3)_2$
The Effect of Limestone/Dolomite on CAN Safety

pH Stabilisation by Limestone/Dolomite

The rate of reaction can be influenced by:
- pH of granules
- filler type
- drying and grinding conditions for the filler
- granulation temperature
- product moisture
Common AN/CAN Granulation Processes

High solid recycle processes ($R \geq 1.5$), e.g.

- Pugmill
- Spherodizer
- Drum

and low solid recycle processes ($R \leq 1$):

- Fluidised bed
- Pan
- Fluidised Drum

Granulation and recycle System

The Uhde Pugmill Granulation Process

Process Units

- Granulation and recycle System
- Combined cooling / drying air system
- Process air treatment
- Process water recycle and evaporation
- Wet cleaning system
The Uhde Pugmill Granulation Process

Granulation and Recycle System

- Filler / Additive
- AN melt
- Granulator
- Screens
- Lump crusher
- 2-Roller-crusher
- Cyclones
- Fluid-bed cooler
- Drying drum
- Cyclones
- Coating drum
- Final product

AN melt
Filler / Additive

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Combined Cooling / Drying Air System

- Waste gas
- Fluid-bed cooler
- LP steam & condensate
- Drying drum
- Air conditioning unit
The Uhde Pugmill Granulation Process

Design and Operating Characteristics (1)

Uhde considers the pugmill to be best-suited for CAN production:

**Flexibility:**
- full range of N content from below 22 to 33.5%N, no downtime necessary in between product types
- tolerance regarding filler materials from nitrophosphate lime to dolomite (and gypsum); filler materials and additives can be added as dry matter without premixing

**Inherent safety:**
- low melt temperature (< 160°C), low melt concentration (95-96%), low granulation temperature (< 120°C)
- no need for filler/additive pre-mixing in hot concentrated melt

**Process stability:** high recycle makes plant self-regulatory, disturbances are balanced out

**Product quality:** hard and uniform product without seed preparation systems or scalping screens
The Uhde Pugmill Granulation Process

Design and Operating Characteristics (2)

- **Maintainability:**
  - no melt spraying system, therefore no wear in liquid system
  - minimum amount of proprietary equipment, locally produced spare parts

- **Energy efficiency:** autothermal (or near autothermal) CAN production; relatively low energy consumption

- **Environmental:**
  - dual use of cooling/drying air, minimising waste air flows
  - wet scrubbers reduce effluents well below BAT (‘Best Available Technique’) levels; no AN aerosols are produced
  - no liquid effluents, wash water is collected and recycled (except for floor spillages)

- **Cost efficient:** total plant cost comparable with or lower than for other granulation processes

Further Improvement of the Uhde Pugmill Granulation

Research and Development

- **Dolomite and Limestone Assessment**
  - reproducible extensive testing
  - evaluation of granulation behaviour

- **Granulation Additives**
  - Stabilisation for thermocycling

- **Control of Filler Reactivity**
  - adjustable premixing of AN melt and filler

- **Fertilisers with Sulphur Content**
  - Granulation with Gypsum/Anhydrite
  - Granulation plant extendable for ASN production
Conclusion

The Uhde Pugmill is the ideal Granulation Process for CAN because

- of its capability to produce the whole range of N-content
- it is tolerant regarding filler material and additives
- of its high degree of safety also compared to low recycle processes
- of the high product quality
- emissions are well below BAT-level
- investment, energy and maintenance costs are reasonably low