The Uhde Pugmill Granulation

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

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Prepared for Presentation at the 2006 IFA Technical Symposium
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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

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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)

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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

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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 $CaCO_3$ and
- Magnesium carbonate $MgCO_3$

The stabilising effect results from the following reactions:

- $2\ HNO_3 + CaCO_3 \Rightarrow Ca(NO_3)_2 + H_2O + CO_2$
- $2\ HNO_3 + MgCO_3 \Rightarrow Mg(NO_3)_2 + H_2O + CO_2$

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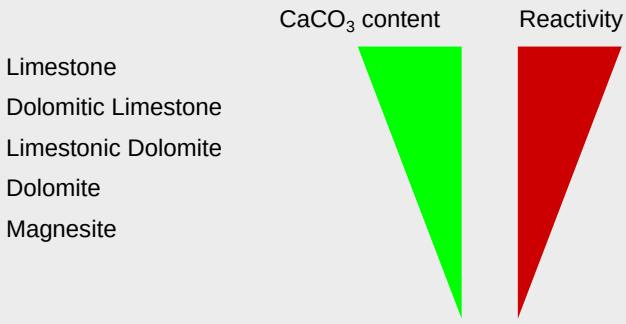
The Effect of Limestone/Dolomite on CAN Safety

Reactivity of Limestone/Dolomite

Reactivity is the measure, how much of the carbonates is converted into their nitrates:

$CaCO_3 \Rightarrow Ca(NO_3)_2$ and $MgCO_3 \Rightarrow Mg(NO_3)_2$



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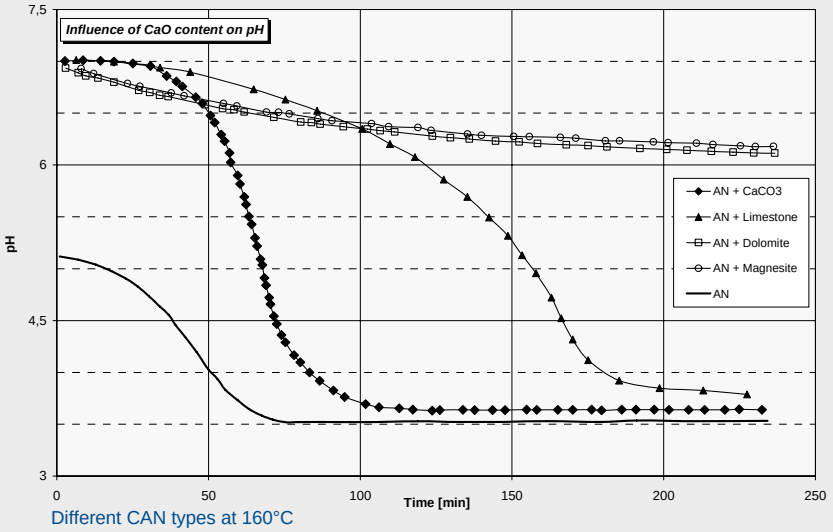
The Effect of Limestone/Dolomite on CAN Safety

pH Stabilisation by Limestone/Dolomite



Different CAN types at 160°C

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The Effect of Limestone/Dolomite on CAN Safety

Conversion Reaction Control during Production

The rate of reaction can be influenced by:

- pH of granules
- filler type
- drying and grinding conditions for the filler
- granulation temperature
- product moisture

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Common AN/CAN Granulation Processes

High solid recycle processes (R ≥ 1.5), e.g.

- Pugmill
- Spherodizer
- Drum

→ low AN melt concentration
→ low AN melt temperature
→ full dry recycle

and low solid recycle processes (R ≤ 1):

- Fluidised bed
- Pan
- Fluidised Drum

→ high AN melt concentration
→ high AN melt temperature
→ partly redissolving recycle

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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

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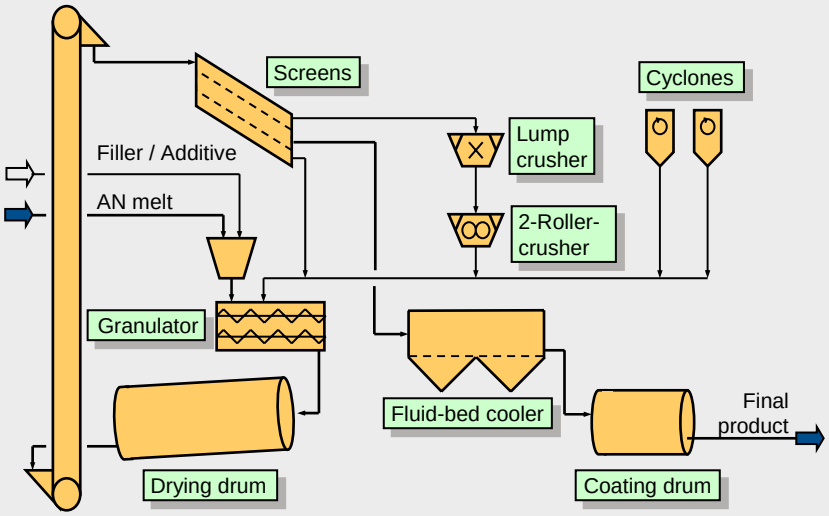
The Uhde Pugmill Granulation Process

Granulation and Recycle System



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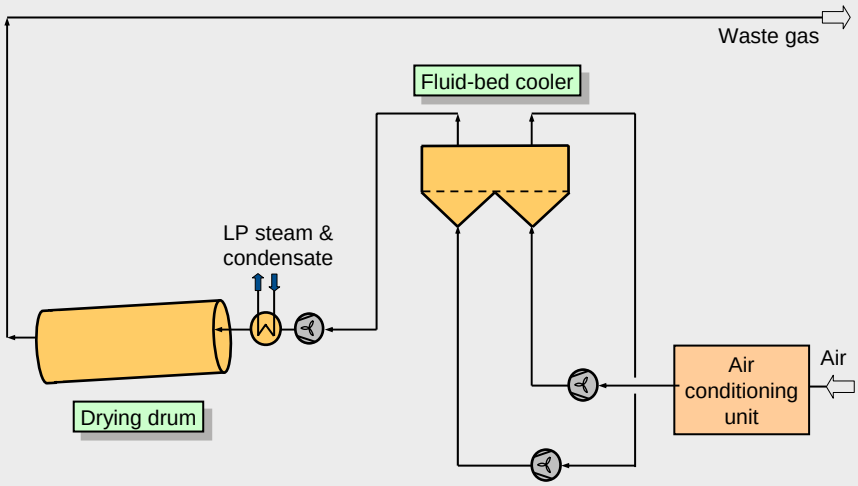
The Uhde Pugmill Granulation Process

Combined Cooling / Drying Air System



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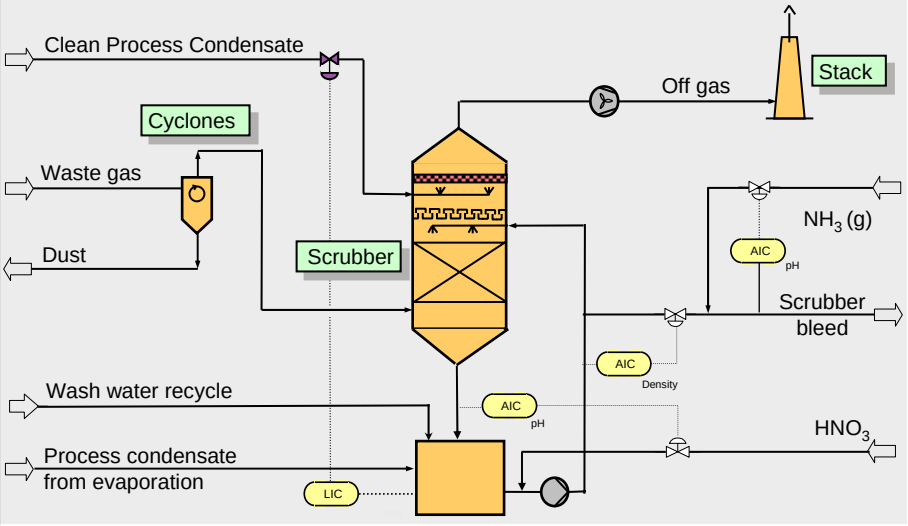
The Uhde Pugmill Granulation Process

Process Air Treatment



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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

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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

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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

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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

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