Integrated Process Solutions.

Granulation & Agglomeration Seminar 2016, 25th October, Rotterdam
Innovations in Fluidized Bed Granulation Technology

Ursula Litzke, Glatt Ingenieurtechnik Weimar
Presentation Overview

- Company History/structure
- Processing Options with fluid bed
- Batch / Continuous Operation Overview
- Fluid Bed / Spouted Bed Technology
- Laboratory Unit ProCell LabSystem
- Application Examples
Glatt History Worldwide

1954  company foundation
1959  delivery of the first fluid bed dryer for the pharmaceutical industry
1961  move to Binzen and attend first time on ACHEMA
1964-66 development fluid bed granulation
1970  introduction of Wurstercoating process
1971  foundation Glatt AG Pratteln (CH)
1972  foundation Glatt Air Techniques (USA)
1981  delivery of the first granulation line
1981  foundation offices in DK, F, UK
1983  delivery first continuous fluid bed unit
1991  foundation GIT (Weimar) + GST (Dresden) extension in FFF application

today international group with 2000 employers worldwide
International Glatt Group
Organization and Structure

Pharmaceutical Services
Process Technology Pharma
Process & Plant Engineering
Process Technology FFF

Pharmaceutical Industry + Biotechnology

Food, Feed & Fine Chemical Industry

Product Development
Contract Manufacturing
Process Technology
Process and Plant Engineering
Validation Qualification
Particle Design
Process Technology
Contract Manufacturing

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Fluid Bed Technologies - Process Options

**spray granulation**
granules and pellets from liquids

**agglomeration**
granules from powder

**coating**
encapsulation of particles with liquids

**encapsulation**
(micro-)encapsulation of liquids

**powder layering**
encapsulation of particles with powder
**Agglomeration of Powder**

- porous particle with "raspberry" structure
- solidified binder liquid respectively immobilized liquid

**WHAT OF?**
- of powders
- immobilization of liquids

**WHERE?**
- in the fluidized bed
- rotor
- high shear mixer

**WHERBY?**
- by top spray
- by bottom spray
- by tangential spray (rotor)

**WHEREWITH?**
- solutions (binder)
- suspensions (binder)
- emulsions (binder)
Spray Granulation of Liquids

WHAT OF?
» spray granulation of liquids
» encapsulation of liquids

WHERE?
» in the fluidized bed

WHEREBY?
» by top spray
» by bottom spray

WHEREWITH?
» solutions
» suspensions
» emulsions
» melts
Coating - Encapsulation of Particles with Liquids

WHAT OF?
» encapsulation of particles with liquids

WHERE?
» in the fluidized bed
» drum (pan) coated

WHEREBY?
» by top spray
» by bottom spray
» by Wurster

WHEREWITH?
» solutions
» suspensions
» emulsions
» melts
## Batch Fluid Bed Technologies
### Types of Equipment

<table>
<thead>
<tr>
<th>Type</th>
<th>Process Option</th>
<th>Lab Scale</th>
<th>Production</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WSG</strong></td>
<td>Agglomeration top spray / HP spray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drying</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>GPCG</strong></td>
<td>Agglomeration top / tangential / HP spray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>top / bottom / HP spray</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pelletizing</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>tangential spray / CPS</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Drying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WS Combo</strong></td>
<td>Agglomeration top / bottom / HP spray</td>
<td></td>
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## Continuous Technologies
### Types of Equipment

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</tr>
</thead>
<tbody>
<tr>
<td>AGT</td>
<td>fluid bed spray granulation top / bottom spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GF</td>
<td>fluid bed spray granulation top / bottom spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>agglomeration top / bottom spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>coating top / bottom spray</td>
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<td></td>
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<tr>
<td></td>
<td>drying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ProCell</td>
<td>spouted bed spray granulation top / bottom spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>agglomeration top / bottom spray</td>
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Fluid Bed Technology - Main Parts of Batch Units

- Clean gas chamber
- Expansion chamber
- Processing chamber
- Inlet air chamber
- Exhaust gas
- Filter
- Spraying system
- Bottom screen
- Process gas inlet
# Fluid Bed Technology

## Process Option
- agglomeration, particle coating, drying

## Operation Mode
- batch

## Fluid Bed Equipment
- WSG, WS Combo, GPCG with top spray insert

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- filter housing
- top spray system
- processing chamber/product vessel
- bottom screen
- inlet air chamber

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## Fluid Bed Technology

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<td>particle coating, powder coating, agglomeration, drying</td>
<td>batch</td>
<td>WS Combo, GPCG with Wurster-bottom spray insert</td>
</tr>
</tbody>
</table>

- **Filter housing**
- **Expansion chamber**
- **Wurster tube**
- **Processing chamber/product container**
- **Bottom spray nozzle**
- **Bottom screen**
- **Inlet air chamber**
**Fluid Bed Granulation**

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<td>agglomeration, drying</td>
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**Diagram:**
- **Wurster tube**
- **bottom spray nozzle**

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## Fluid Bed Technology

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### Diagram
- **Filter housing**
- **HP tangential spray system**
- **Processing chamber/product vessel**
- **SpinFlow® bottom screen**
- **Inlet air chamber**
Fluid Bed Technology - Main Parts of Batch Units

- Filter housing
- Exhaust
- Filter
- Expansion chamber
- Spraying system
- Processing chamber
- Bottom screen
- Inlet air chamber
- Process gas inlet
Fluid Bed Technology - Main Parts of Continuous Units

- Filter housing
- Expansion chamber
- Processing chamber
- Inlet air chamber
- Spraying system
- Product feed
- Product discharge
- Bottom screen
- Process gas inlet
- Exhaust
- Filter
Fluid Bed Technology - Main Parts of Continuous Units

- Solid raw material (silo)
- Dosing system
- Rotary valve
- Discharge of Product non-classifying

# Fluid Bed Technology

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<td>spray granulation</td>
<td>continuous</td>
<td>Glatt Spray Granulator AGT</td>
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</table>

- exhaust housing
- filter
- top-spray nozzle
- expansion chamber
- processing chamber
- dust return/seeds
- raw material feed
- bottom screen
- inlet process air
- inlet air chamber
- non classifying discharge
# Fluid Bed Technology

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- exhaust housing
- filter
- top-spray nozzle
- expansion chamber
- processing chamber
- dust return/seeds
- raw material feed
- bottom screen
- inlet process air
- inlet air chamber
- classifying air
- Internal classifying discharge tube

## Fluid Bed Technology

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<tbody>
<tr>
<td>spray granulation, agglomeration, coating, micro encapsulation, drying</td>
<td>continuous</td>
<td>Glatt Fluid Bed Granulator GFG</td>
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</tbody>
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**Diagram Elements:**
- Solid feed
- Clean gas chamber
- Filter chamber
- Spray system
- Expansion chamber
- Processing chamber
- Bottom screen
- Product discharge
- Inlet air chambers

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<td>continuous</td>
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expansion chamber
processing chamber
bottom screen
Fluid Bed Technology

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</table>

- solid feed
- spray system
- expansion chamber
- processing chamber
- bottom screen
- product discharge
- inlet air chambers

24.10.2016
Handling of particles there are difficult to fluidize concerning:

- very wide grain size distribution or
- irregular surface structure (tend to aggregate)
- very fine powder
- Particle with length/diameter relation > 1
- high stickiness
- heat sensitive products
- residence time sensible processes
ALL fluid bed processes can be realized:

- no bottom screen  no caking, easy cleaning
- “controlled” particle movement  homogenous wetting
- hot air enters at point of spraying  latent heat of evaporation is cooling the product
- no fluidization outside of spray zone  particles return to spouting zone without contact the hot air
- less temperature stress for product  shorter residence time because design of processing chamber allows less bed material compared to fluid bed
- granulation of product particle size down to 50 µm
### Spouted Bed Granulation-

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>spray granulation, agglomeration, coating, micro encapsulation, drying</td>
<td>continuous</td>
<td>Glatt Spouted Bed Granulator ProCell</td>
</tr>
</tbody>
</table>

- solid feed
- pure gas chamber
- filter chamber
- expansion chamber
- processing chamber
- product discharge
- central air guide
- spray system
- inlet air chambers

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ProCell LabSystem - Processing Options

» ProCell system with ProCell 5 and ProCell 10 inserts
  - continuous **spouted bed**: spray granulation, encapsulation
  - batch **spouted bed**: agglomeration, coating

» Vario system with Vario 3 and Vario 7 inserts
  - continuous **fluid bed**: spray granulation, encapsulation
  - batch **fluid bed**: agglomeration, Wurster coating

» GF system with GF 5 insert
  - continuous **fluid bed**:
    - spray granulation, encapsulation, agglomeration, coating, drying

» AGT system with AGT 2 insert
  - continuous **fluid bed**:
    - spray granulation

» Rotor system with Rotor 7
  - batch **fluid bed**:
    - powder layering, spheronizing, direct pelletizing
## ProCell LabSystem - Technical Data

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process gas volume</td>
<td>40 - 250 m³/h</td>
</tr>
<tr>
<td></td>
<td>500 m³/h option</td>
</tr>
<tr>
<td>Inlet air temperature</td>
<td>200 °C</td>
</tr>
<tr>
<td></td>
<td>300 °C option</td>
</tr>
<tr>
<td>Air flow velocity</td>
<td>0.5 - 5 m/s</td>
</tr>
<tr>
<td>Grain sizes</td>
<td>0.1 - 5 mm</td>
</tr>
<tr>
<td>Working volume</td>
<td>0.4 - 38 l</td>
</tr>
<tr>
<td>Spray rate</td>
<td>0.2 - 18 l/h</td>
</tr>
<tr>
<td>Material flow</td>
<td>200 g/h - 15 kg/h</td>
</tr>
<tr>
<td>Batch size</td>
<td>500 g/batch - 30 kg/batch</td>
</tr>
</tbody>
</table>
ProCell PilotSystem - Apparatus Main Parts

ProCell 25 insert

GF 25 insert
# ProCell PilotSystem - Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process gas volume</td>
<td>400 - 2,000 m³/h</td>
</tr>
<tr>
<td>Process gas temperature</td>
<td>200 °C</td>
</tr>
<tr>
<td>Process gas velocity</td>
<td>0.5 - 2 m/s</td>
</tr>
<tr>
<td>Grain sizes</td>
<td>0.1 - 3 mm</td>
</tr>
<tr>
<td>Working volume</td>
<td>10 - 40 l</td>
</tr>
<tr>
<td>Spray rate</td>
<td>5 - 75 l/h</td>
</tr>
<tr>
<td>Material flow</td>
<td>5 - 30 kg/h</td>
</tr>
<tr>
<td>Process gas volume</td>
<td>400 - 2,000 m³/h</td>
</tr>
</tbody>
</table>
Application Agglomeration

instant tea  
herbs  

cacao  
curcuma  

instant soup  
tomato + olive  

glass mixture  

casein
Application Coating / Powder Layering

fertilizer
stayzyme
seeds

plastic foam
fertilizer
enzymes

catalyst
zeplite
Industrial diamonds

fertilizer, stayzyme, seeds, plastic foam, enzymes, catalyst, zeplite, Industrial diamonds
Glatt Ingenieurtechnik Weimar Technology Center

- HACCP
- consulting
- lab units
- analytics
- pilot plants
- scale-up
- QS / ISO
- powder synthesis
- consulting
- lab units
- analytics
- pilot plants
- scale-up
- contract manuf.
- logistics
- storage facilities
- wet granulation
- extrusion
- pelletizing
- tabletting
- media
Process Technology Food, Feed & Fine Chemicals
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Thank You for Your Attention

Questions?