Pneumatic Conveying Technologies
A Practical Guide for the Plastics Industry

Joe Lutz

AGENDA

- Pneumatic Conveying System Concepts
- Improving Existing Pneumatic Conveying Systems
- Dust and Streamer Removal
Railcar, Truck or Container Unload

Storage Silos

Vacuum System

Vacuum OR Pressure System

Vacuum OR Pressure System

Day Bins

Extruder

Dilute Phase Conveying

HIGH Velocity
LOW Pressure
LOW Product-to-Gas Ratio

Optimized Dilute Phase Conveying

Optimized Velocity
LOW to MEDIUM Pressure
MEDIUM Product-to-Gas Ratio

Dense Phase Conveying

LOW Velocity
HIGH Pressure
HIGH Product-to-Gas Ratio
Dilute Phase Conveying

- **HIGH Velocity**
- **LOW Pressure**
- **LOW Product-to-Gas Ratio**

Optimized Dilute Phase Conveying

- Optimized Velocity
- LOW to MEDIUM Pressure
- MEDIUM Product-to-Gas Ratio

Dense Phase Conveying

- **LOW Velocity**
- **HIGH Pressure**
- **HIGH Product-to-Gas Ratio**
<table>
<thead>
<tr>
<th>Vacuum Systems (Dilute)</th>
<th>Pressure Systems (Dilute)</th>
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<tbody>
<tr>
<td>Off the shelf designs are low cost</td>
<td>Equipment and custom design can be more expensive</td>
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<td>Higher velocity required in pickup box causes attrition &amp; wasted energy</td>
<td>Controlled solids dosing =</td>
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<tr>
<td>Less efficient because of pressure limits (~18 &quot;HG/-650 mBar) and low product to air ratio (~5:1 max)</td>
<td>Lower velocities &amp; material is fed with rotary valve into laminar air flow so LESS ATTRITION &amp; LESS ENERGY</td>
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<td>More efficient and LESS ATTRITION operating at higher pressure (1-2 bar) and higher product to air ratios (~15:1 max)</td>
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<tr>
<td>Off the shelf designs are low cost</td>
<td>Constant material feed – no cycling means more capacity</td>
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<td>Uncontrolled solids dosing  = Higher velocity required in pickup box causes attrition &amp; wasted energy –</td>
<td>*Custom design is exactly right for YOUR application</td>
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<td>Less efficient because of pressure limits (~18&quot;HG/-650 mBar) and low product to air ratio (~5:1 max)</td>
<td>*not always!</td>
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### Dilute Phase Conveying Characteristics

- **Not optimized**

- Pellets completely dispersed in gas flow

- **High Gas Velocity:** 5,000-8,000 fpm
- **Low Product to Air Ratio:** 1:1 to 5:1
- **Lower Pressure:** up to 15 psig (18"HG in vacuum)
**Optimized Dilute Phase Conveying Characteristics**

- Pellets partially dispersed in gas flow & partially accumulating at bottom
- Optimum Gas Velocity: 3,000-5,000 fpm
- Med Product to Air Ratio: 5:1 to 15:1
- Med Pressure: up to 30 psig

YOUR EXISTING DILUTE PHASE SYSTEM CAN BE OPTIMIZED!
Pellets move in plugs with low velocity and high pressure.

**Optimum Gas Velocity**: 400-2,000 fpm  
**Med Product to Air Ratio**: 15:1 to 40:1  
**High Pressure**: 50+ psig

Be Careful!
“My transfer system works fine.”

Impurities in end product
Impurities in end product
"My transfer system works fine."

Operations and Maintenance Implications

- Bridging Hoppers
- Jammed Feeders
- Plugged Convey Pickup Boxes & Convey Lines
- Clogged Traps & Screens
- Clogged Loader Filters
Improving Existing Pneumatic Conveying System Performance

**Product**
- Specific density
- Temperature
- Particle size and shape
- Additives

**Operation**
- Velocities
- Product-to-air ratio
- Conveying gas temperature
- Capacity variation

**Plant Layout**
- Length of conveying pipe
- Number of bends
- Type of bends
- Number of diverter valves
- Interior roughness of pipe
- Mis-alignment of pipe and equipment

Dust and Streamer Formation
Key factors for efficient, economical and optimal plant operation

- Stepping pipe diameters
Key factors for efficient, economical and optimal plant operation

- Step positioning

![Diagram showing step positioning]

- Pipe Length
  - 20
  - 40

- Gas Velocity [m/s]
  - Minimum velocity
  - 20
  - 40
Key factors for efficient, economical and optimal plant operation

- Choose correctly aligned pipe connections
- Choose correctly designed conveying components
What’s wrong with the elbows I have now?

Lots of Attrition
Lots of Elbow wear
Compact
Less wear & attrition compared to radius elbow
Lowest cost specialty elbow

Highest pressure loss
Dead spot = Cross contamination
Still a secondary impact zone

Compact
“Lifetime” elbow
No streamers & reduced fines
Configurable

Increased pressure loss (3-10%)
Cost
90 ft – 3” SCH10 Pipe
4 bends

DOW ELITE post-metallocene PE

TOTAL DUST INCREASE PER 1000 LBS OF CONVEYING (ppm)

<table>
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<tr>
<th></th>
<th>Elbows</th>
<th>Pellbows</th>
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<tr>
<td>D&lt;500um</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>D&gt;500um</td>
<td>35</td>
<td>30</td>
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Dust and Streamer Removal
for the Cleanest Material at the Extruder

Dust Collection is NOT Dust Removal!
Angel Hair Trap
Catches streamers
Misses some short streamers
Needs Maintenance
Gravity feed or Convey through

Zick-zack sifter
- Cleans coarse dust
- Removes short streamers
- Builds relatively high
- Gravity fed
Grinder Evacuation – Air Wash
Cleans coarse dust
Removes short streamers
Conveying infeed
EXTRUSION COATING COURSE
August 16-18 Neenah, WI ExtrusionCoatingCourse.org

Closed Loop System with Cyclone & Inline Filter

Railcar, Truck or Container Unload

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Summary

- Conveying technologies have pros and cons
- You can improve your existing system
- Consider BOTH for the best quality:
  #1 – An optimized conveying process
  #2 – A high performance dust removal system
- Ask the experts!!

Thank you for your attention!

QUESTIONS?

Please remember, give us your feedback and suggestions for the next TAPPI seminar.....
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