

pe:etron

Discover Bulkmatology®
The Nature of Bulk Material Handling

The New Thinking in Pneumatic Conveying





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Introduction – Pneumatic Conveying Technology

Selection of the suitable pneumatic conveying transfer system for dry bulk solid materials from pellets to powders is important for the function and the economical, reliable operation of an entire plant. Complex and unreliable systems lead to high maintenance costs and plant shut downs.

Material properties vary in size, shape, surface, weight and other factors, all of which have a significant influence on the sizing and selection of a conveying system. The length of the system and the number of elbows are also very important design factors in the sizing process. In many cases, a conveying test in a pneumatic conveying test lab is necessary to determine the parameters for the correct system calculation. For this reason, Pelletron maintains its own test lab to perform a wide range of pneumatic conveying tests for its customers. The test lab is also the platform for the development of new conveying technologies.



Pneumatic conveying test lab with elbows and Pellbows®. We provide comparison tests for dilute, dense and STRANDPHASE® conveying.



Pneumatic Conveying Creates Dust and Streamers

All types of conveying systems create contaminants depending on factors like conveying method, plant layout and pellet type.

Major Factors

Pellet Characteristics

- Hardness
- Particle shape, size and surface

Temperature

- Product temperature
- Conveying air temperature

Velocity

Conveying Line

- Wall material
- Pipe surface
- Number of elbows
- Elbow design
- Pipe routing and length



Blurry surface caused by dust



Black spots caused by burned dust



Build-up on reciprocating screw caused by dust

Why are dust and streamers bad?

Undesirable results:

- High “scrap” rates from fines burning in mold
- Blurry surfaces caused by vaporized dust particles
- Weak spots in fibers
- Flaws in wire insulation
- Gels in films
- Housekeeping problems caused by dust and streamers
- Crusting of feed throat of screw
- Reduced mold and screw life resulting from carbonization of dust
- Mold vents clogged by dust
- Equipment and machines clogged by streamers
- Dust accumulation on silo walls and roofs

Generation of Dust in the Three Conveying Types?

Conveying Type	Dilute Phase	Dense Phase	STRANDPHASE®
Dust type	Fine and coarse dust, long and short streamers, depending on the material	Very fine dust, highly electrostatically charged	Fine and coarse dust, short streamers, depending on the material
Dust removal	Difficult because of high dust volume and streamers	Very difficult to remove electrostatically charged micro dust	Easy
Dust volume	High	Low	Moderate
Investment costs	Low	High	Moderate
Dust removal system	DeDuster® removes dust and all kinds of streamers	DeDuster® removes electrostatically charged dust	DeDuster® removes dust and all kinds of streamers

Recommendations to Reduce the Formation of Dust and Streamers

In order to minimize the formation of dust and streamers, the selection of the systems operating conditions and design is of high importance. The following are recommended system design criteria.

Operating Conditions

- Minimize the product temperature
- Minimize the conveying air temperature
- Minimize the conveying velocity
- Minimize the conveying pressure

System Design

- Optimize pipe routing
- Reduce the number of pipe elbows
- Select suitable pipe material and surface
- Avoid offsets and gas at pipe connections

Design Rules

Granules

The higher the velocity in pneumatic conveying systems, the higher the damage to the conveyed granules

Plastic pellets

High velocities create dust and streamers in plastic resin conveying systems

Abrasive material

High velocities create severe erosion of pipes and components



SOLUTION

In the beginning, there was a thought ...

Pelletron's Solution – The New Conveying Process **pellcon3®**

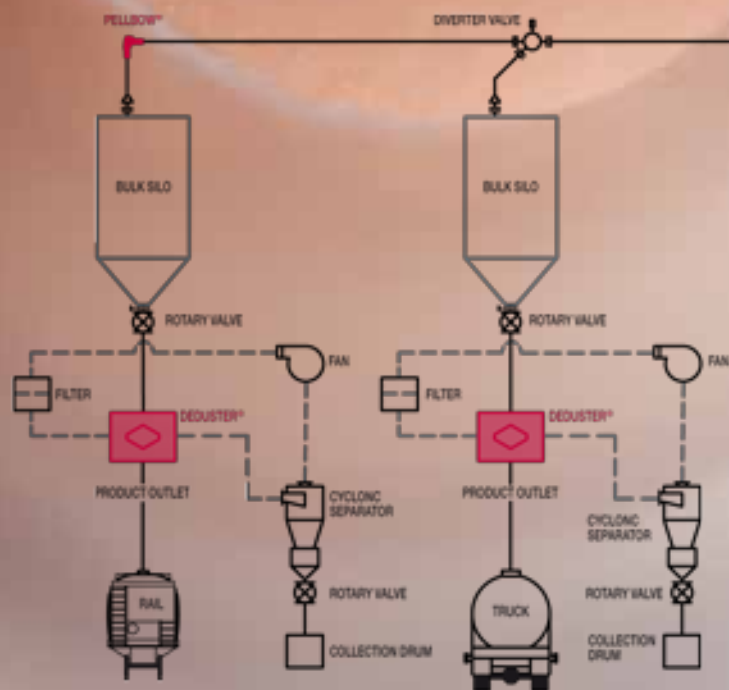
Based on extensive experience in the design and layout of conveying systems, Pelletron created the **pellcon3®** process. This process consists of three major process components:

- STRANDPHASE®
- Pellbow®
- DeDuster®

This **pellcon3®** process does not require special pipe supports or high pressure compressors. It is very economical, and most importantly, it does not create the fine micro dust that is characteristic of dense phase systems or the long streamers that are characteristic of dilute phase systems.

New, high-capacity plants can be designed to utilize this modern technology. Existing dense phase and dilute phase systems can be upgraded to take advantage of the benefits of the **pellcon3®** technology.

This generic flow sheet shows the layout of a modern **pellcon3®** system.



DeDuster® can be stationary or mobile

pellcon3[®]

The New thinking in Pneumatic Conveying



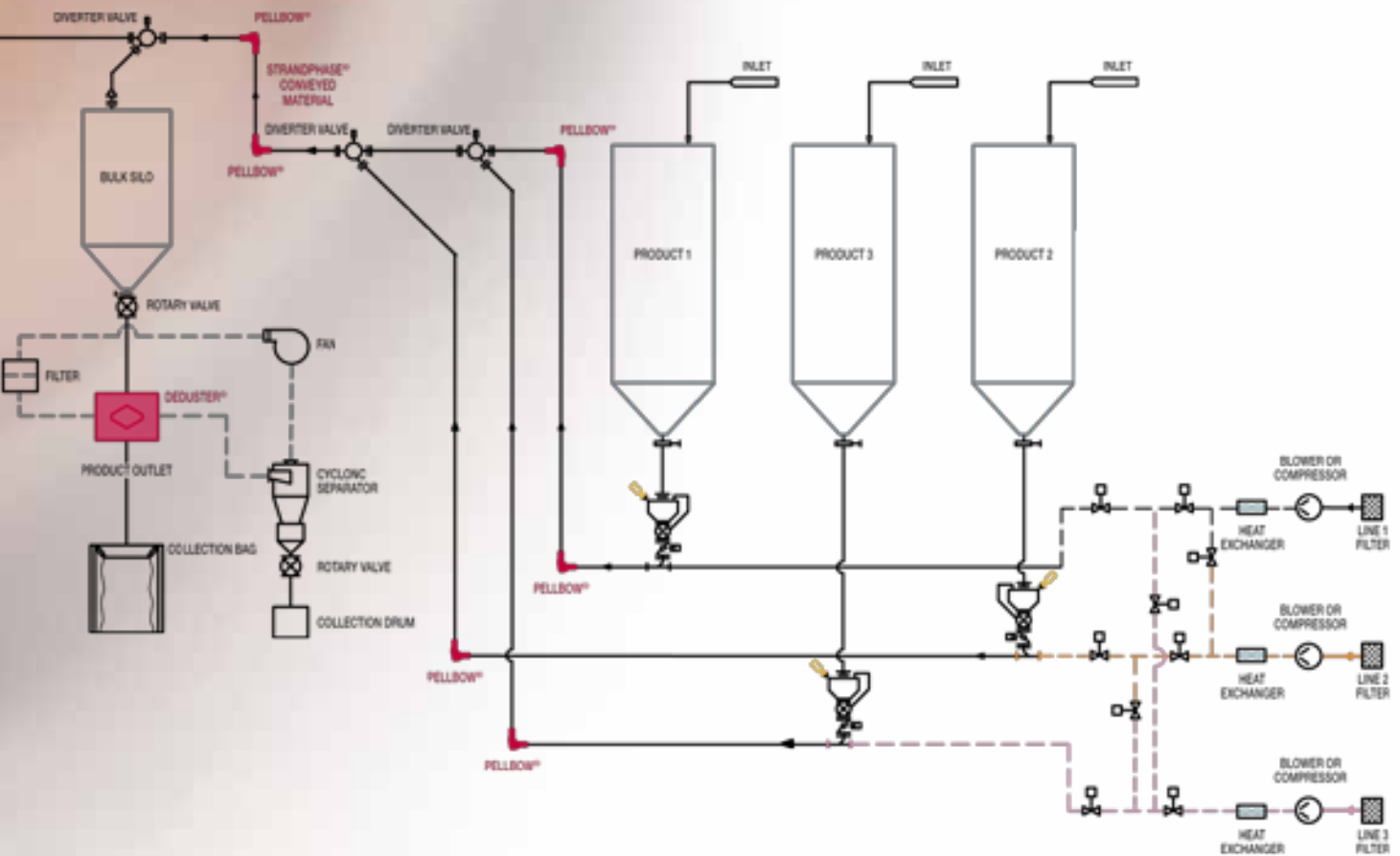
STRANDPHASE[®]



Pellbow[®]



DeDuster[®]





Blower Stations and Heat Exchanger



Rotary Valve Stations

Overview of Various Conveying Technologies

Traditionally, dilute phase was the technology of choice for conveying. Today, other options are available from slow motion dense phase and STRANDPHASE® conveying to special bypass systems for sticky powders. The major characteristics of dilute, dense and STRANDPHASE® conveying are illustrated on the right and described as follows.

Dilute Phase Conveying



Product completely dispersed in gas flow

High gas velocities: $v=25 - 40$ m/s (5,000 – 8,000 ft/min)

Low product-to-air ratio: range 1 – 10 to 1

Low to medium pressure drop: $p = 0.1 - 1.0$ bar (1.5 – 15 psig)

Dense Phase conveying



Product moves in plugs throughout the pipe

Low gas velocities: $v=2 - 10$ m/s (400 – 2,000 ft/min)

High product-to-air ratio: range 15 – 50 to 1

High pressure drop: $p = 0.5 - 3.5$ bar (7 – 50 psig)

STRANDPHASE® conveying



Product partially dispersed in gas flow, partially moving at higher concentration at bottom of horizontal runs

Optimized gas velocity: $v=15 - 25$ m/s (3,000 – 5,000 ft/min)

Medium product-to-air ratio: range 5 – 20 to 1

Medium to high pressure drop: $p = 0.5 - 2.0$ bar (7 – 30 psig)



Diverter Valve



Dilute Phase Conveying System with Long Radius Elbows

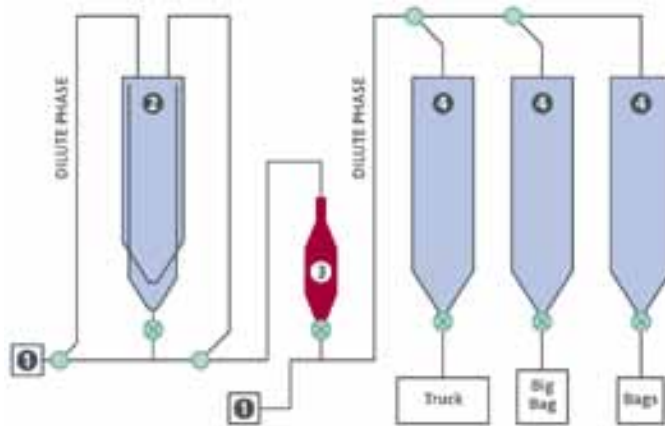
Dilute Phase Conveying

Dilute phase conveying uses high gas velocities at low pressures and the conveyed product is completely dispersed in the gas flow. Vacuum conveying systems are available for small conveying capacities and distribution of product from one source to multiple destinations. Pressure conveying systems are available for larger capacities and longer distances.

The investment cost for dilute phase conveying systems is very economical, but the technology has a number of disadvantages. Due to the high velocity, there is significant degradation of conveyed pellets resulting in the generation of dust and streamers. The use of dilute phase for abrasive products also causes wear of the conveying line and the pipe elbows.

In the past, pressure dilute phase systems were used in combination with an elutriator, located in front or on top of the receiving silos, to remove the dust generated during conveying. These technologies were not completely satisfying because of the low quality of the conveyed pellets and high product loss due to the formation of dust and streamers. In order to solve these problems, other technologies including dense phase conveying were developed.

Layout of a traditional polyolefin plant using dilute phase conveying.



1 Compressed Air Supply 2 Blender 3 Elutriator (dedusting) 4 Storage Silos

These systems can be **upgraded** easily with mobile or stationary DeDusters® located under the silos.



Traditional solution with elutriator

Modern solution with stationary or mobile DeDuster®

Dust Distribution Table

Dust Particle size	Dust Analysis (wet)	
	Percent %	Grams g
>500 µm	2.246 %	0.1071
63 to < 500 µm	60.985 %	2.9080
20 to < 63 µm	20.984 %	1.0006
< 20 µm	15.785 %	0.7527
TOTAL	100.000 %	4.7684

The table above shows an analysis of the fine micro dust content and the distribution of dust after cleaning pellets in a PET dense phase system with a DeDuster®. The fine dust content below 63micron was in the range of 35%. The wet test was carried out in accordance with ASTM standard D7486-08.



Typical plug in a dense phase conveying system

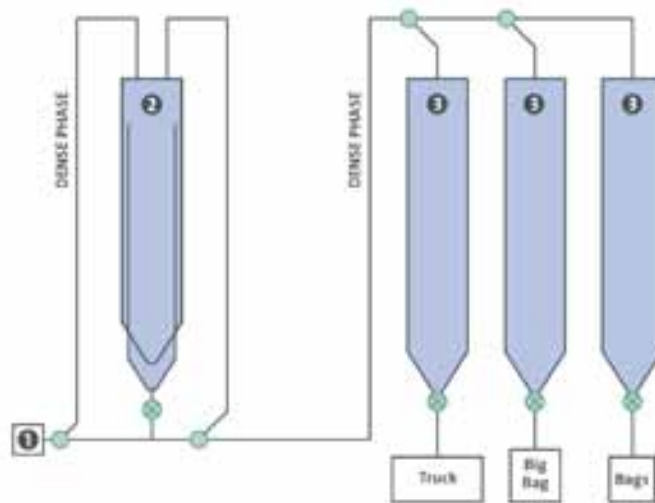
Dense Phase, Plug or Slow Motion Conveying

The demands of the market for high quality end products were the driving force behind the development of systems that produced less degradation of both the conveyed material and the piping. Moving pellets with low velocity and high pressure through piping systems was the next step in the development.

The idea was to generate less dust and eliminate the requirement for dedusting of the conveyed material. This effort was only partially successful. Dense phase conveying eliminated the creation of streamers (angel hair), but the friction between pellets and between the pellets and the wall caused by high pressure generates a very fine dust. This dust is difficult to remove because of its high electrostatic charge. The dust sticks to the pellets, silo walls and roofs. The sudden dust surges that occur when emptying the silos are common problems in dense phase conveying systems. As a result, dense phase conveying systems required dedusting, preferably installed under the storage silos before packaging or final processing.

The pipe forces created by the plugs in large-scale dense phase systems with large pipe diameters and long distances posed another challenge. Special pipe supports and additional steel structures are necessary to compensate for the pipe forces. These additional requirements increase the cost of equipment, installation and maintenance. Therefore, further research was necessary to find better conveying solutions.

Layout of traditional polyolefin plant based on dense phase conveying without dedusting.



1 Compressed Air Supply 2 Blender 3 Silo

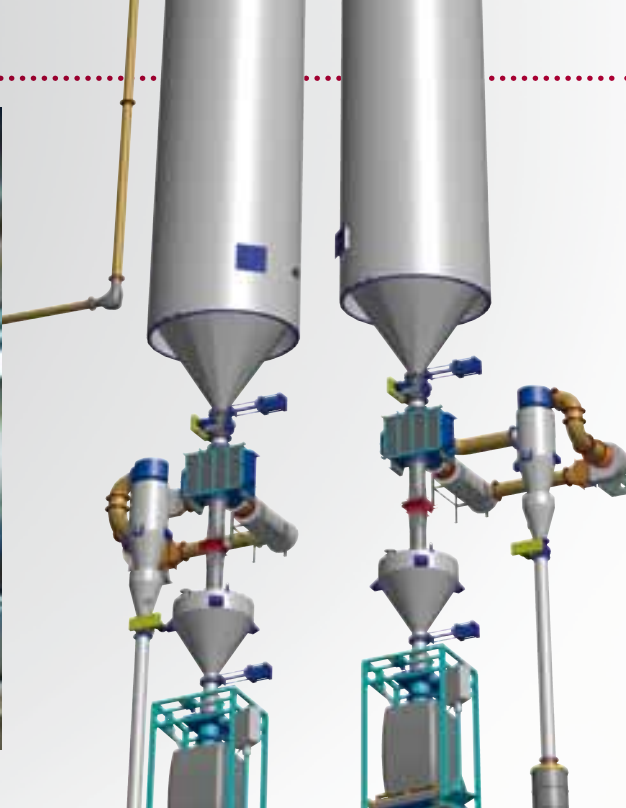
These systems can be upgraded easily with mobile or stationary DeDusters® located under the silos.



Modern dense phase system with stationary or mobile DeDuster®



Moving a mobile DeDuster® into operating position

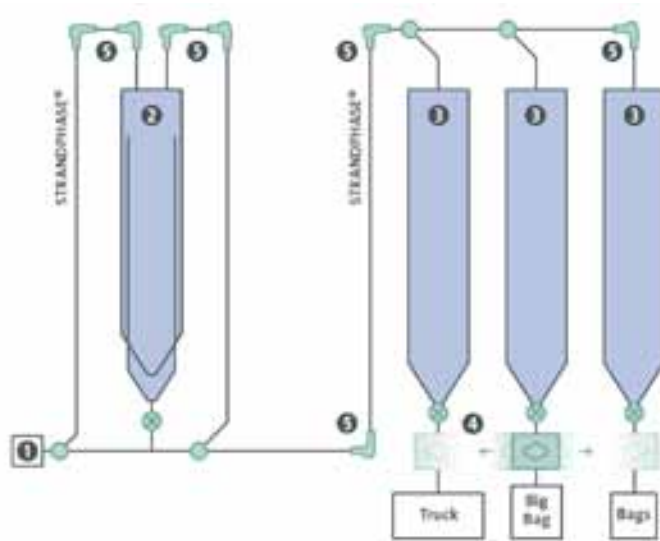


STRANDPHASE® Conveying

For large scale transfer systems, Pelletron recommends using STRANDPHASE® conveying. The characteristics of this system are a high product-to-air ratio with conveying pressures up to 2 bar (30psi), within the typical range of positive displacement blowers and oil free screw compressors. It uses optimized conveying velocities in combination with Pellbows® (specially designed pipe elbows) and a DeDuster® installed before packaging or processing of the conveyed pellets.

With STRANDPHASE® conveying, attrition is moderate and the Pellbows® prevent the creation of streamers. A DeDuster® removes the moderate dust content and guarantees a very high quality end product. For silo farms, Pelletron offers mobile dedusting systems that can be moved easily under the silos to remove the dust before rail car/truck loading or bagging of the product.

STRANDPHASE® conveying does not require any special pipe supports or additional steel structures. In many cases, the pipe diameters are smaller when compared to dense phase systems. Because of these advantages, the investment cost for large-scale STRANDPHASE® systems is much lower than for slow motion dense phase systems. STRANDPHASE® systems offer low investment costs and are easy to operate and to maintain.




1 Compressed Air Supply 2 Blender 3 Silo 4 DeDuster® (mobile or stationary) 5 Pellbow®

For new installations, Pelletron recommends the pellcon3® system, utilizing STRANDPHASE® conveying, Pellbows® and DeDusters®.

Which is the best conveying technology for your system?

There is no simple answer to the question of which conveying system is the best solution for a specific application. Selection of the conveying technology depends on a variety of factors such as total system length, conveying capacity, and material to be conveyed. Use the guidelines shown in the table as a starting point.

CONVEYING TECHNOLOGY RECOMMENDATIONS FOR PLASTIC PELLETS				
Conveying technology	Conveying line size & distance			
	<DN150 & <150 m <6" & <500 ft	<DN150 & >150 m <6" & >500 ft	>DN150 & <150 m >6" & <500 ft	>DN150 & >150 m >6" & >500 ft
Dense Phase	✓ ✓	✓ -	-	- -
STRANDPHASE®	✓	✓	✓	✓ ✓

 Recommend
  Not recommend

Comparison Between STRANDPHASE® and Dense Phase Conveying

The tables below compare the main characteristics of STRANDPHASE® and a dense phase system.



PNEUMATIC CONVEYING DATA COMPARISON

REFERENCE

Product	PET pellets	
Bulk Density	640 kg/m ³	40 lbs/ft ³
Capacity	15,000 to 30,000 kg/hr	33,000 to 66,000 lbs/hr
Distance	91 m horizontal, 31 m vertical	300 ft horizontal, 100 ft vertical
Elbows	10 elbows 90°	

STRANDPHASE®

Slow Motion Dense Phase

CONVEYING DATA COMPARISON

Pipe Diameter	DN 150	6" sch10	DN 200	8" sch10
Conveying Air Flow	35 m ³ /min	1,230 scfm	21 m ³ /min	750 scfm
Purge Air Flow	N/A		45 m ³ /min	1,600 scfm
Conveying Pressure	0.83 bar	12 psig	2.5 bar	36 psig
Product-to-Air Ratio	12 to 1		25 to 1	

CONVEYING EQUIPMENT COMPARISON

Rotary Valves	Standard Design		High Pressure	
	Up to 1.52 bar	22 psig	Up to 3.1 bar	45 psig
Conveying Air Source	Positive displacement blowers		Screw Compressor or Compressed Air Network	
Pipes	Standard Surface		Smooth Surface	
Elbows	Pellbows®		5D or 10D Elbows	
Cleaning Equipment	DeDusters®		DeDusters®	



Prevention of dust and streamers – The Pellbow® Technology

The Pellbow® Eliminates Streamers and Reduces Dust

To minimize the creation of dust and streamers, the Pellbow® provides ideal features when used in combination with STRANDPHASE® conveying.

The Pellbow® has a patented elbow design that resembles a standard, short-radius elbow with a large expanded chamber between the inlet and discharge of the elbow. After the inlet, a sharp step (Bernoulli Step) creates an area of expansion within the elbow and a deceleration zone for the incoming particles. This slowdown leads to the formation of a fluidized slurry in the product-to-product primary impact zone. The slurry constantly moves upward toward the discharge and re-acceleration zone at the Pellbow® exit.

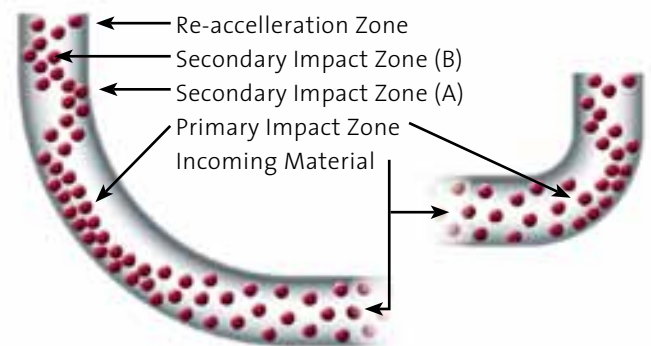
The step just inside the elbow inlet creates a low pressure zone that draws the product from the primary impact zone back across the elbow's bottom toward the inlet and into the main product stream. This allows a complete cleanout that is less sensitive to the actual conveying velocity than other elbows.

The benefits of Pellbows® over other elbows include a defined primary product-to-product impact zone, compact design with low space requirements and low noise levels. The soft impact of pellets and the low wall friction in the slurry zone eliminates the creation of streamers. Its pressure loss is only slightly higher than that of standard long- and short-radius elbows. The creation of the product-to-product impact zone requires a minimum product-to-gas ratio of approximately 3:1.

Recommended Pellbow® applications include the handling of fluidizable powder products and any resins or pellets that are abrasive, heat-sensitive and/or fragile, and they can be used in dilute and STRANDPHASE® systems. Pellbows® are available in aluminum, stainless steel, carbon steel and other special alloys, and are suitable for pellet and powder transfer.

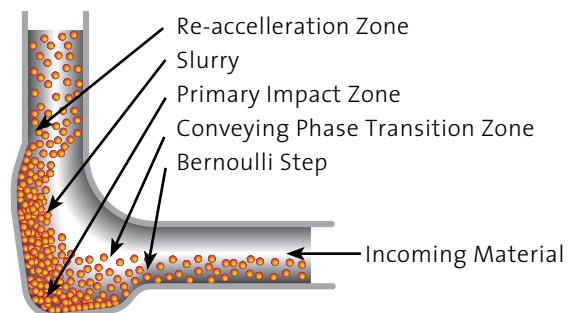
Standard Long-Radius Elbow

Short Radius Elbow



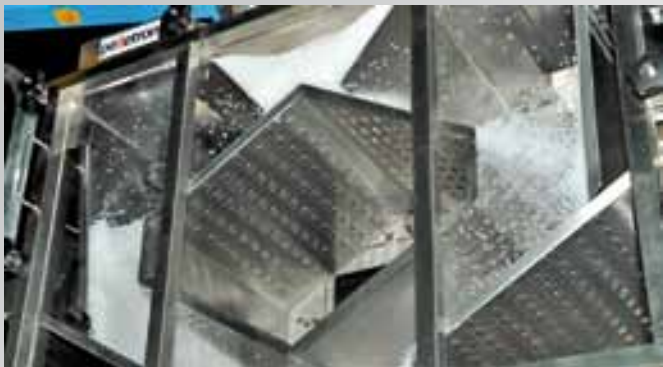
Standard elbows are made by bending a straight section of pipe.

The Pellbow® Technology



A step near the Pellbow's® inlet prevents particle accumulation by creating a low-pressure zone that draws product across the elbow's bottom.

DeDuster®



DeDuster® in use cleaning plastic pellets



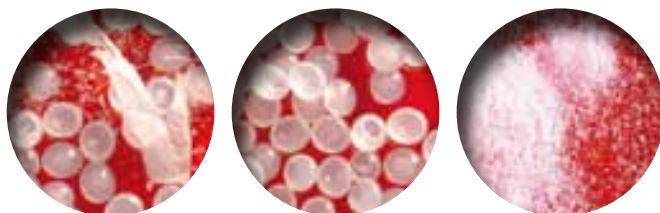
RC DeDuster® in use cleaning regrind

Dust removal – The DeDuster® Technology

Pelletron has developed a variety of DeDusters® to remove dust and streamers.

Pelletron DeDusters® use a magnetic flux field to disrupt the electrostatic charge between micro-dust and pellets, and a patented air wash deck to separate and remove these contaminants.

Pelletron provides DeDusters® for the plastic processing and plastic manufacturing industries, as well as for food, mineral, pharmaceutical, chemical and other applications. DeDusters® are available in sizes ranging from 100lbs/h (50kg/h) up to 200,000lbs/h (100t/h).

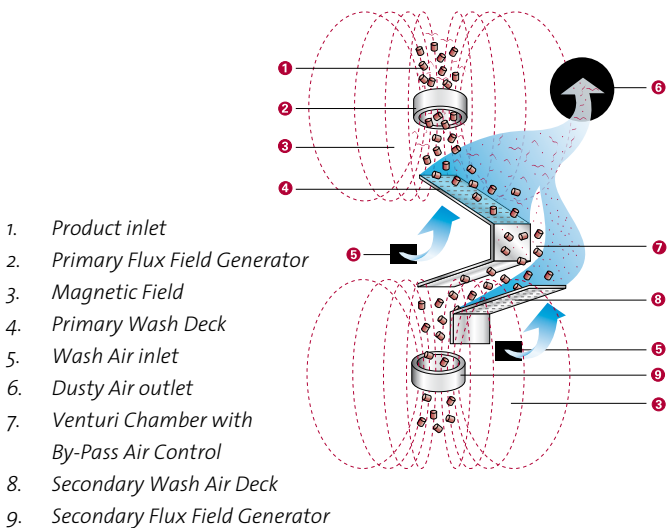


Dusty Material

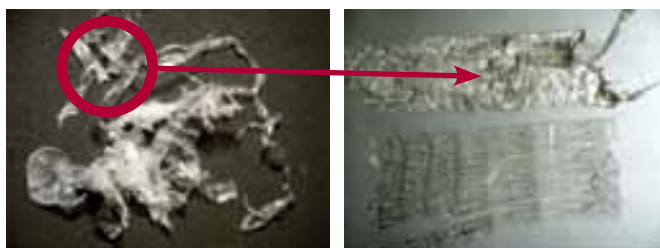
DeDusted Material

Dust

OPERATING PRINCIPLE



XP-DeDuster® uses one
Primary Flux Field Generator only



Removed streamers

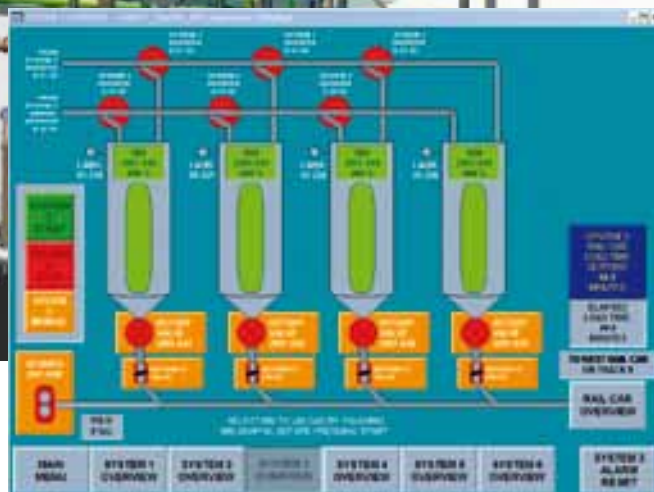
> 2000 µm

Customers investing in dedusting equipment want to compare the dust and streamer content before and after cleaning and, in many cases, require a performance guarantee. Therefore, Pelletron recommends a complete dust analysis to define the contaminants before and after dedusting. Pelletron has developed procedures and analysis equipment for this purpose. Free-of-charge dedusting tests, including a dry and wet test analysis presented in an electronic report format, are available. The dry and wet dust analysis for dry bulk materials is provided in accordance with ASTM and European standards.



System engineering

Pelletron’s highly specialized Bulkmatology® team has many years of knowledge and experience in designing and building systems that meet the unique and individual needs of its customers. Whether it is de-bottlenecking an existing system or designing a complete turnkey plant from the ground up, Pelletron’s extensive know-how and experience ensures that solutions are efficient, cost-effective and meet the industry’s highest standards of quality. Pelletron’s project managers are familiar with national and international standards, and are supported by its local service providers and suppliers.



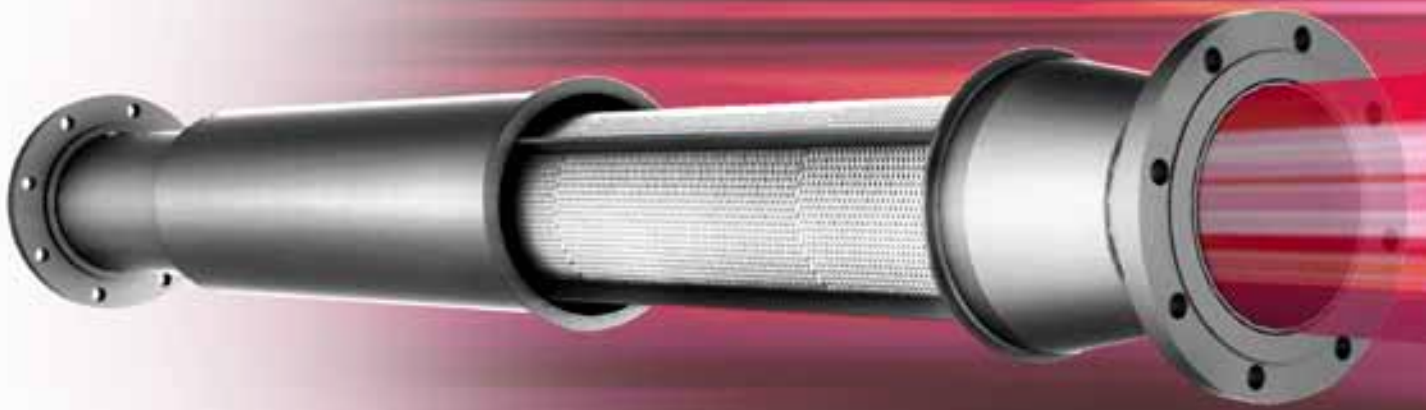
Pelletron’s system services include:

- System design/engineering
- System analysis & optimization
- Project management
- Instrumentation & controls
- Installation
- Field service
- Global sourcing
- Commissioning
- Pneumatic conveying and dedusting tests
- Toll cleaning
- Spare parts & re-furbishing
- And more...

Pelletron’s application experience includes:

- Railcar loading and unloading systems
- Pneumatic transfer systems
- Bagging stations
- Big bag filling stations
- Truck loading and unloading systems
- Extruder feeding
- Upgrading dilute and dense phase systems to pellcon3® systems
- And more...

FlowEnhancer™

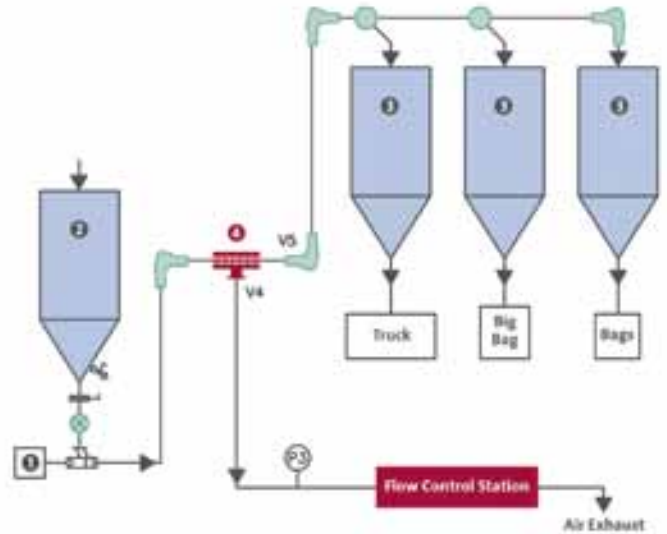


System Optimizing - The FlowEnhancer™ Technology

Long conveying systems require stepping of pipes in order to achieve a continuous velocity profile throughout the system. Instead of stepping the pipe, Pelletron offers the patented FlowEnhancer™, an air extraction solution.

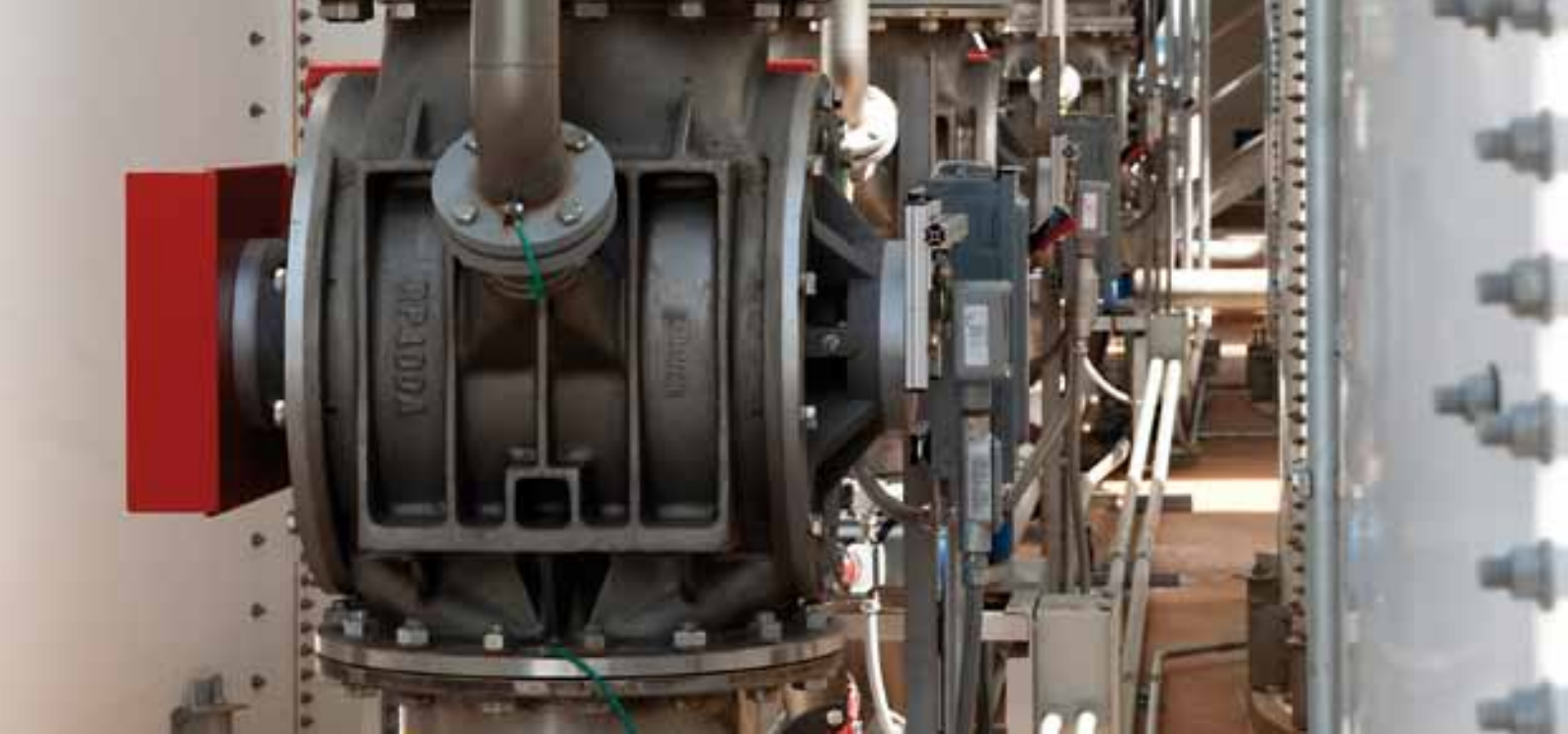
Advantages of an air extraction system:

- Flexibility to reduce air velocity in existing or new pressure conveying systems without stepping the pipeline
- Ability to increase conveying capacity in existing or new pressure conveying systems without modifying the pipeline, blower or components
- Ability to expand the length of existing pipes in pressure conveying systems without modifying the pipeline
- Changes of conveyed material grades possible due to simple adjustments of the air extraction
- Locations of air extraction more flexible compared with stepped pipelines
- Air extraction makes retrofit possible
- Easy to install
- Moderate costs to retrofit an existing system
- Economical alternative to dense phase system. Lower cost, easy to operate, moderate product degradation



1 Compressed Air Supply 2 Silos 3 Receiving Silo 4 FlowEnhancer™

The location of the FlowEnhancer™ in a conveying system is critical for maximum precision and efficiency.



Pneumatic Conveying Components

Modern conveying systems require reliable and economical components. Pelletron has developed new, energy saving rotary valves, special pipe elbows, trade named Pellbow®, and DeDusters® that provide solutions for all kind of applications.



Rotary Valves

- Granular and powder products
- Medium pressure and high pressure design available



Diverter Valves

- Granular and powder products
- Medium and high pressure applications



Slide gates

- Granular and powder products
- Medium and high pressure applications



Pellbow®

- Special pipe elbow to reduce dust and eliminate streamers
- Wear resistant design



Mid Series
P10 to P200 are equipped
with single wash decks



Max Series
P400 to P2000 are equipped
with double wash decks



XP Series
XP15 to XP900 are equipped
with double wash decks

DeDusters® for various applications

P-Series DeDuster® Traditional low height design

DeDuster® type	capacity range in lbs/h	capacity range in kg/hr
P1	50 – 150	20 – 75
P5	100 – 600	50 – 300
P10	500 – 1,200	250 – 600
P30	1,000 – 3,500	600 – 1.600
P50	3,000 – 5,500	1.500 – 2.500
P80	5,000 – 9,000	2.300 – 4.000
P120	8,000 – 14,000	3.500 – 6.500
P200	12,000 – 22,000	5.500 – 10.000
P400	20,000 – 45,000	9.000 – 20.000
P600	40,000 – 65,000	18.000 – 30.000
P800	60,000 – 90,000	27.000 – 40.000
P1200	80,000 – 130,000	36.000 – 60.000
P2000	120,000 – 220,000	54.000 – 100.000

XP-Series DeDuster® X-tra low heigh & energy consumption

DeDuster® type	capacity range in lbs/h	capacity range in kg/hr
XP5	650 – 1,100	300 – 500
XP15	1,000 – 3,500	600 – 1.600
XP45	8,000 – 11,000	3.500 – 5.000
XP90	12,000 – 22,000	5.500 – 10.000
XP180	20,000 – 45,000	9.000 – 20.000
XP360	60,000 – 90,000	27.000 – 40.000
XP540	80,000 – 130,000	36.000 – 60.000
XP720	120,000 – 180,000	54.000 – 80.000
XP900	150,000 – 220,000	70.000 – 100.000

RC-Series DeDuster® with CentraCone™



Energy saving technology provides increased capacities at low height design. Other sizes available upon request.

DeDuster® type	capacity range in lbs/h	in kg/hr
RC1	50 – 150	20 – 75

Special Series DeDuster®



OS DeDuster® designed for offset discharge applications. Available in various sizes upon request.



DO-DeDuster® designed for dual outlet discharge applications. Available in various sizes upon request.



Global Sales and Service Network

With an international network of bulk material handling experts, Pelletron is committed to providing the highest level of quality, service and expertise to our valued Bulkmatology® customers all around the world.

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Tokyo • Japan



pelletron

Discover **Bulkmatology**®
The Nature of Bulk Material Handling