Therec Engineering & Consulting Co., Ltd.

The Pneumatic Conveying Company

THEREC Powder & Bulk Processing Companies

Story By *Pichait Thakeprasit / Engineering Director*

Therec Engineering & Consulting Co., Ltd.

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Pneumatic Conveying System

(Practical Procedure Hand Book)

Pneumatic conveying system

What is pneumatic conveying system

- **Concept**
- Pneumatic conveying system is the way to convey bulk material by air in the pipe line.
- Bulk materials are Dust, Powder, Pellet, Flake and Pieces, those are all we counted.
- We can identify it in to three categories

1. **Lean phase , (**Loose phase or Dilute phase**)**
2. **Mixed phase . (**Two phase or Multi phase**)**
3. **Dense phase**

("But some one may not talk about mixed phase, it also may called as early stage of dense phase or last stage of lean phase.")

Pneumatic conveying system

What is pneumatic conveying system

- **Concept**
- There is no international law to say sharply about the rule of identifying but every body in the world will use these two factors to divide it,

"How the individual material **perform** in any individual conveying system?"

"Product per Air ratio , **μ**"

Pneumatic conveying system

What is pneumatic conveying system

- **Concept**
- We are turn-key designer and many times are system integrator ,not the university professor and this book is the practical book ,not the book that the student will use in the class, so after this we will only tell all about

- **How we think?**
- **How we calculate ?**
- **How we do?**
- **And what we achieve?**

- There is no strictly concern about how any book from any professor say and identify.

Pneumatic conveying system

What is pneumatic conveying system

- **Theory**
- All the theory in this book may adopted from many books and many articles which you all can find from the book store and internet.

- All the data in equipment calculation and operation would be from many of world class suppliers both we are representing and the ones we are not. Including with some which are our competitors those we need to learn about their product very carefully to fight with them.

- Also from our own equipment which is copied , duplicated and developed in our company for more than twenty years.

Pneumatic conveying system

What is pneumatic conveying system

- **Theory**
- And the last and most important content of this book is the experience and cases which we got along through 20 years of work By

“Thousands units of Blower and Valves which we Sell”

“Thousands units of component which we Produce ”

“Thousands units of Blowers which we Install & Commissioning”

“ And Hundred over Systems that of we have Done”

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Pneumatic conveying system

What is pneumatic conveying system

- One thing we must remember is , there is no difference product that really action in he same way in the same condition of conveying system.
- If we put the site glass, we may see some product go as the dense phase in one condition but some product still go like mixed, it is depending on the individual product characteristic.
- We must known it well before convey it.
- There is no précised way to predict this beside testing and experience.
- But there are many books and many professor which may indicated these in some deference
- Detail, we just need to looking at one and create our knowledge, experience and finally conceptual design style to be of your own.
- (Your need to choose …….)
- Later pages is some of the ideas from two difference books

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Pneumatic conveying system

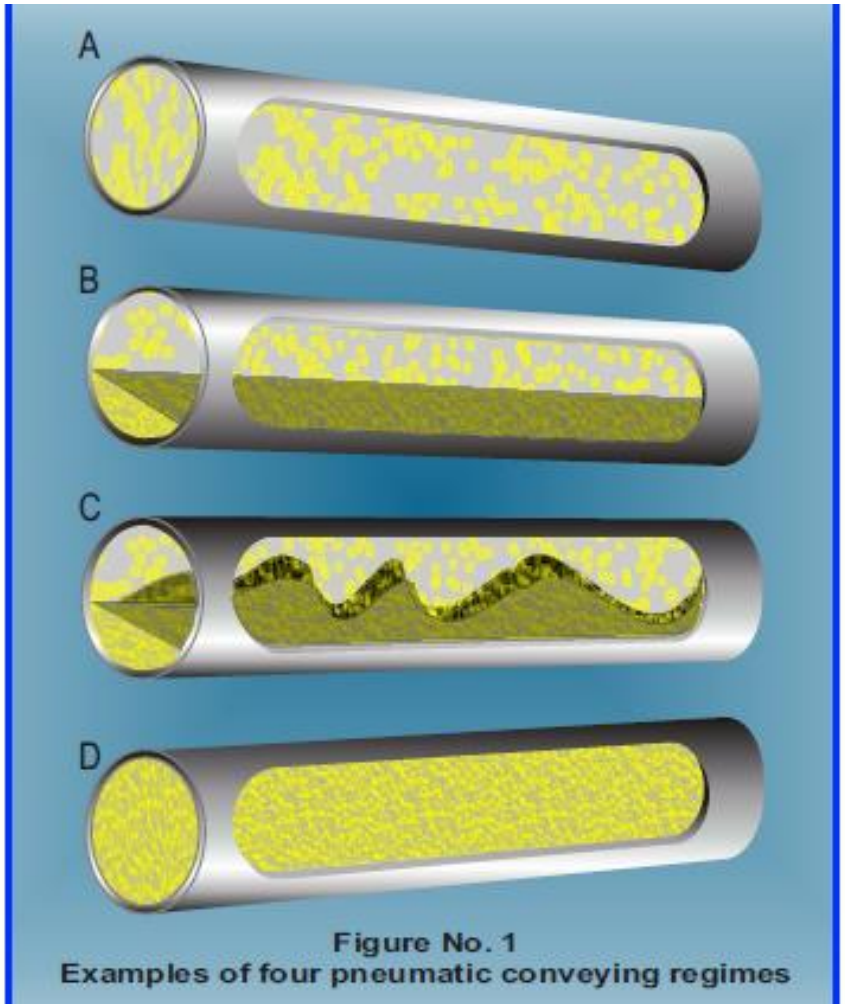

Figure No. 1
Examples of four pneumatic conveying regimes

- **A**. Dilute phase conveying regime, velocity above the saltation velocity (flying velocity) mostly between 3,800 to 8,000 ft/min, for long distance up to 700 ft (215 meter). No good for abrasive and fragile material.
- **B.** Mixed phase,(multi phase) , highest velocity below the flying velocity 1,400 to 4,500 feet/ min, suitable for powder and narrow particle size distribution, considerable designed for fragile and abrasive material but may not be the optimized choice
- For long and very long distance up to 8,000ft (2,450 meter)

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Pneumatic conveying system

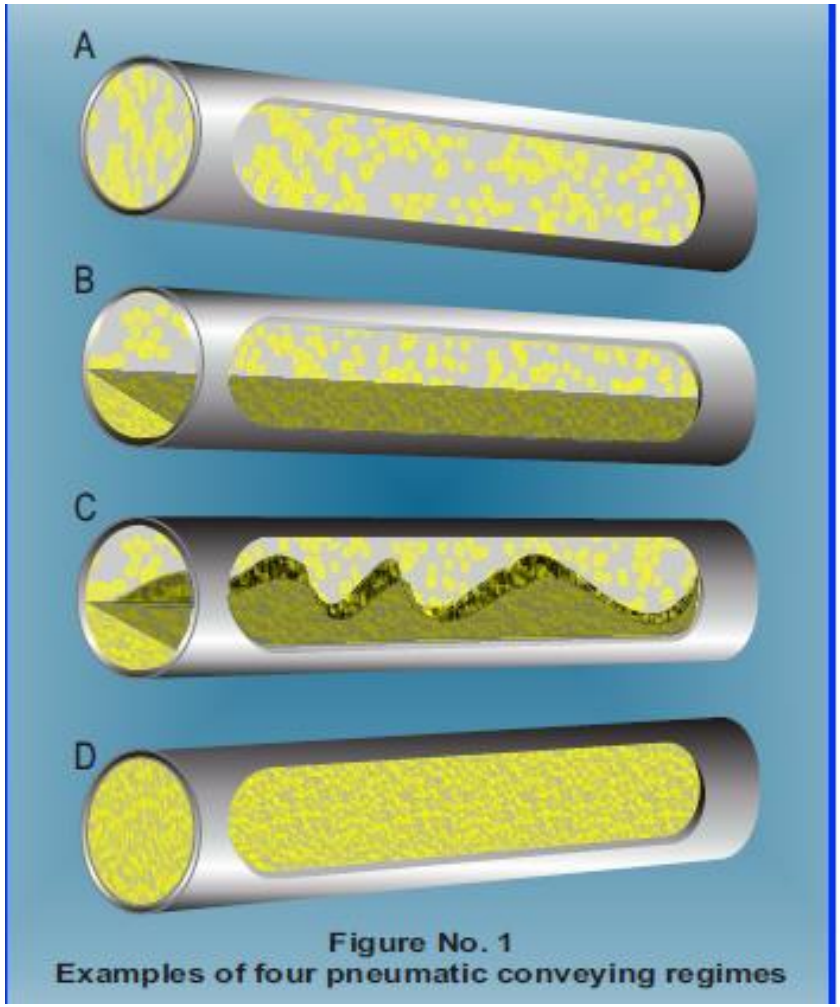

Figure No. 1
Examples of four pneumatic conveying regimes

- **C. Low velocity discontinuous (plug flow) dense phase** material velocity 700 to 2300 ft/ min,
- Moving in pipe in dune-like
- action, good designed for fragile and abrasive material Good for both short and long distance up to 1200 ft (365 meter).
- **D. Low velocity solid dense**
- **Phase** very low material velocity 200 to 1400 ft/min, pipe line almost full, very good for abrasive and fragile martial, only for short distance under 300 ft (92 meter)

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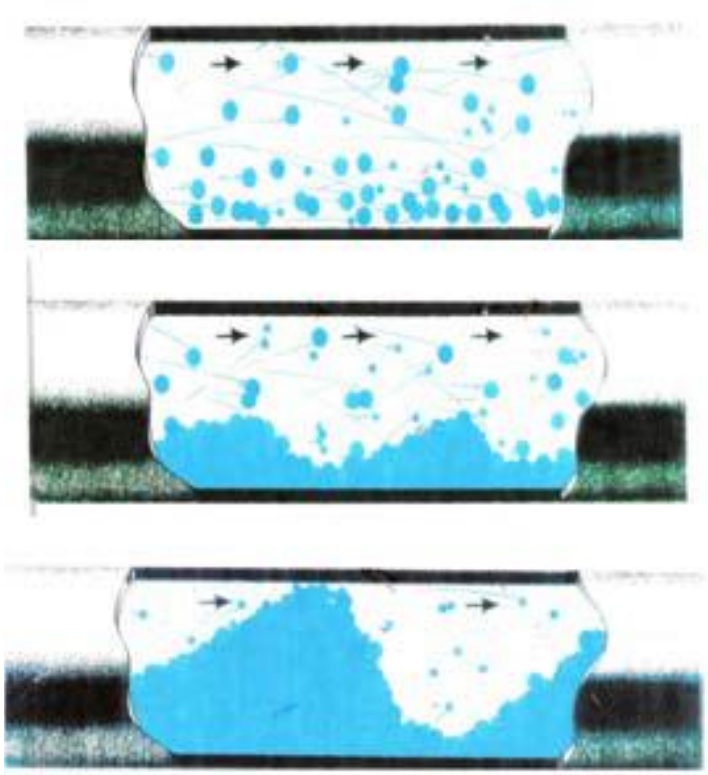

Top: Dilute Phase,
Middle: Mixed Phase,
Bottom: Dense Phase

Dilute Phase, Loose phase, Lean phase

* Above the saltation(flying)velocity
- Typically less than 6 pounds solids per pound of air

Two Phase (mixed phase)

* Below saltation velocity
- 6-100 pounds of solids per pound of air

Dense Phase

- 20-500 pounds of solids per pound of air

* *Permeable piston*

- Special feed method required to form plugs

* *Non permeable*

- Special feed method required to form plugs
- Air assist, by-pass, etc. required to limit plug length

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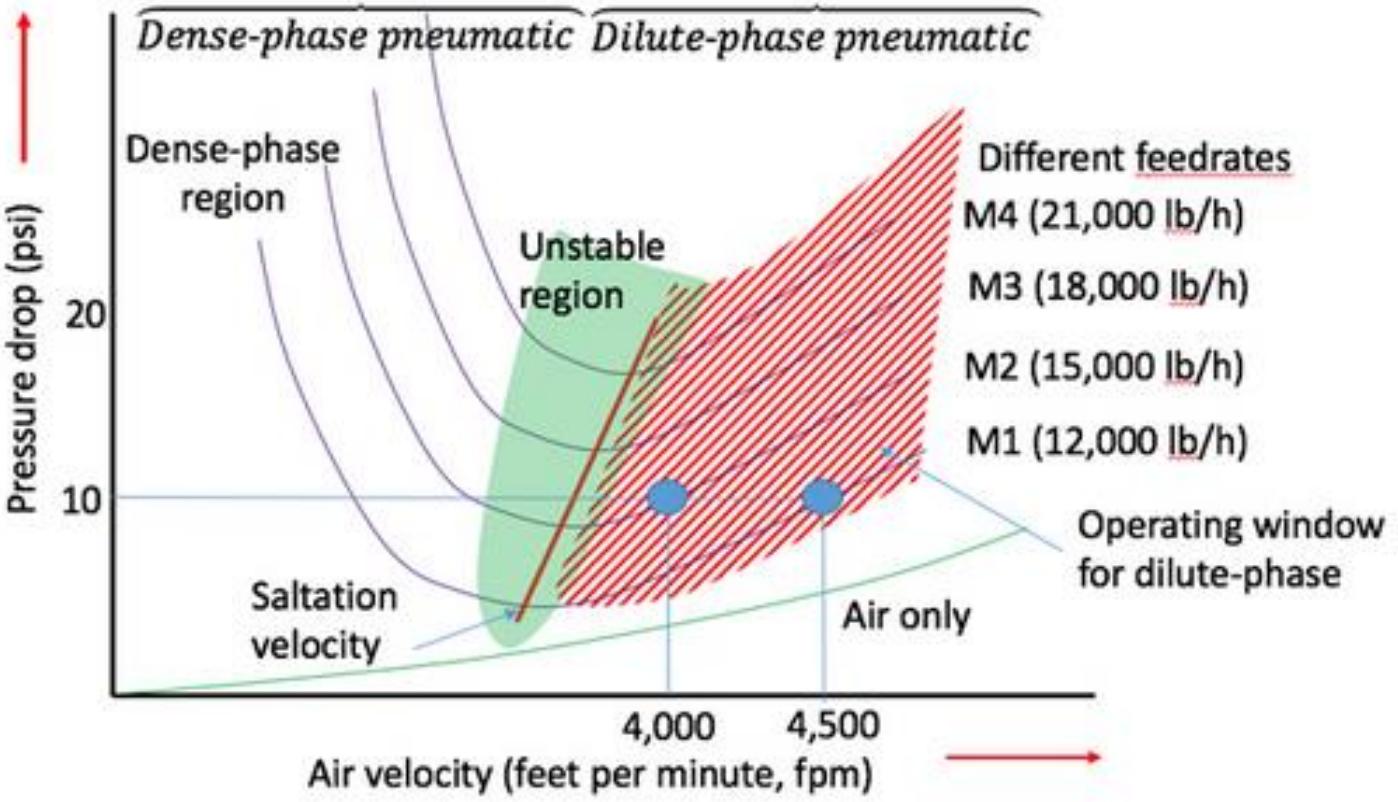
Pneumatic conveying system

Figure 1

Phase diagram of a typical pneumatic conveying system



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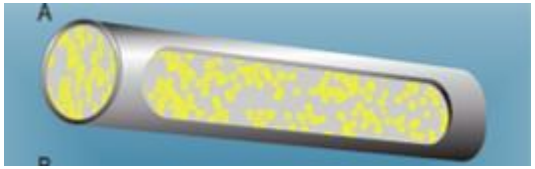
But because of there is no strict rule for the phase explanation, this is all just to be able to study and fixed the coefficient value of the action of the air and product in the pipe to be nearest of the real value.
So for us we mostly set it into 4 stage like below and predict it in separated way of each stage both in design and commissioning process



Dilute Phase Pneumatic conveying system, which may be called as Loose phase or Lean phase

Work principle is / to blow (or suck) the product to fly in the pipe / with the wind speed that higher than flying velocity of that product
/ by low pressure and high air flow air (or gases)

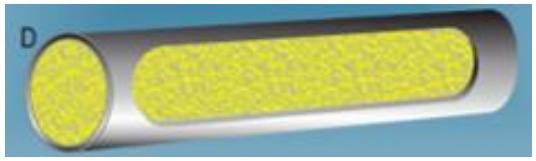
Final Stage Dilute Phase Pneumatic conveying system, which may be called as Beginning stage of Mixed phase

Work principle is / to blow (or suck) the product to fly in the pipe / with the wind speed that relatively lower than flying velocity of that product / by relatively low pressure and high flow of air (or gases)

Pneumatic conveying system

Mixed Phase Pneumatic conveying system, which may be called as Discontinuous (Plug Flow) Dense phase

Work principle is / to blow the product to fly in the pipe / with the wind speed that lower than flying velocity of that product / by relatively high pressure and low flow of air (or gases)



Dense Phase Pneumatic conveying system, which may be called as Continuous (Solid) Dense phase

Work principle is / to push the product to move in the pipe / with the wind speed that a lot lower than flying velocity of that product / by high pressure and low flow of air (or gases)

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Pneumatic conveying system

What is pneumatic conveying system

- **Theory**

- So when come back to the ***"Air Mass per Product Mass"*** ratio or **μ"**
- Any system using ration below 6 is considered real **Lean phase system**

- From 10 to 20 is considered as **Mixed phase** convey

- Any system which is using **μ** above 20 , we will call it all **Dense phase.**

- But when we talk about the **material action**, we must see it to justify

Pneumatic conveying system

What is pneumatic conveying system

- There are some more words to identify the system like

- In the sense of conveying we can say in the other way as
- **Lean phase is to blow it to fly.**
- **Dense phase is to push it to move.**
- **Mixed phase is the mixed action of both**

- In the sense of pressure , we may look at any system and say
- **Which has pressure over 1.2 bar as the dense phase.**
- **And system which has the pressure below that is the mixed phase or lean phase.**

- You all can see the similar and the difference in how to describe the system, , all is not wrong.

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Lean phase / Dilute phase pneumatic conveying system

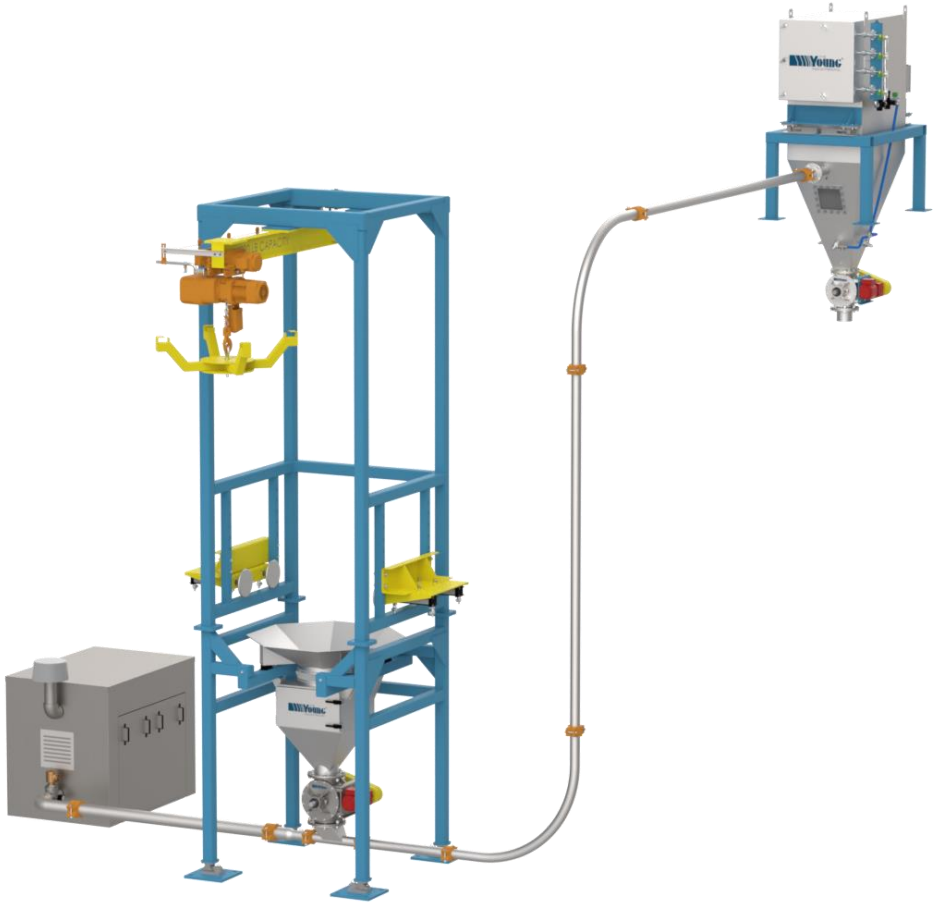
Positive Pressure - Dilute Phase

Positive pressure systems are normally utilized for conveying product from a single entry point to one or more destinations. The positive system uses a minimum air quantity to move a given amount of product. Material can be transported over relatively long distances using the positive pressure system.

When required, step line conveying systems can be employed to provide relatively constant conveying velocities to minimize product degradation during the conveying cycle.

Pneumatic conveying system

Lean phase / Dilute phase pneumatic conveying system



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Lean phase / Dilute phase pneumatic conveying system

Negative Pressure – Dilute Phase

Negative pressure pneumatic systems are well suited for conveying material from a number of inlet points such as unloading rail cars, transporting and discharging product into a single point.

Pneumatic systems are used when a variety of feed configurations may be required, and are almost always used when handling toxic materials to avoid accidental discharge to the atmosphere.

When required, step line conveying systems can be employed to provide relatively constant conveying velocities to minimize product degradation during the conveying cycle.

Combination Pressure - Dilute Phase

The pull-push system incorporates the advantages and benefits of both negative and positive pressure arrangements in a single system. Systems are used where there are multiple material entry points, and multiple delivery points. Typical applications include drawing materials from several points for batching before entering process and unloading from several points such as rail cars with delivery to bulk storage.

When required, step line conveying systems can be employed to provide relatively constant conveying velocities to minimize product degradation during the conveying cycle.

Lean phase / Dilute phase pneumatic conveying system

Closed Loop - Dilute Phase

Closed loop systems are used for handling hazardous chemicals, hygroscopic materials and extremely dusty products. Products such as TPA, caustic soda, and IPA require protection from the atmosphere and particularly oxygen. These materials may be transported pneumatically in a closed loop system using an inert gas as the conveying medium.

Both negative and positive pressure conveying systems are adaptable to closed loop design.

This type of system is especially adaptable to edge trim conveying applications and for use in conjunction with rotary knife cutters, reduction mills and similar process machinery which require an air draw for proper operation.

Lean phase / Dilute phase pneumatic conveying system

Centrifugal Blower - Dilute Phase

Blower systems can be positive pressure, negative pressure, combination negative/positive pressure, or closed loop systems. They are similar to other pneumatic systems, except that centrifugal blowers replace the positive displacement power packages.

The design of this type system is limited in static pressure capability and usually to relatively short distances. In the case of a thru-the-fan pull/push centrifugal blower system, the product must be adaptable to passing through the blower.

Pneumatic conveying system

Fourteen Steps of pneumatic conveying system building

1. Material Classification, Testing & Checking
2. Capacity & Operation Method Evaluation
3. Piping & Routing Checking
4. Area of Installation Classification
5. System Clarification, Test & Type Choosing
6. Main Equipment Choosing
7. Pneumatic Conveying System Design
8. Engineering Diagram and Drawing
9. The 4 main Equipment Design
10. Project clarification
11. Production and or installation
12. Commissioning
13. Documentation and report
14. Service and Maintenance

- Requirement Evaluation Steps
- System design Steps
- Operation Steps

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