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Pneumatic Conveying System For Chilli Handling: A Review

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Abstract:In the industries where bulk material is to be transferred from one place in the process plant to the other, material handling systems are required. Various types of conveyors are available in the market having their own characteristic features. But in the industries where very high mass flow rates are required, pneumatic conveying system can be very useful. Various other conveyors are also present but some occupy a lot of space in the plant whereas some cannot give such high mass flow rates.

Pneumatic conveying system is not a very new concept. A vast literature and research is available on pneumatic conveying system. But despite of such large literature available on pneumatic conveying system, we don't have a general design procedure for any such system since in pneumatic conveying system every problem is a unique problem. But definitely some general principles can be applied while designing a pneumatic conveying system which can lead to an optimum system design. A variety of materials can be conveyed using a pneumatic system with certain changes in the design of the system. We cannot predict the behavior of any pneumatic conveying system. The behavior of any system can only be known by fabricating the system and testing the conveying characteristics of the system for the particular material.

Keywords: Pneumatic conveying , industries , literature ,materials.

INTRODUCTION:

The design data for some materials are available in the different material handling design data books. If one wants to design a system for any new material the he can start the design by comparing the material physical properties with the materials which have already been conveyed. Pneumatic conveying system is a conventional material handling system like belt conveyor or chain conveyor. The main advantage of pneumatic conveying system is that material is transferred in close loop, thereby preventing the environmental effect on the material and vice versa. there is wide scope for experimentation in the field of pneumatic conveying system.

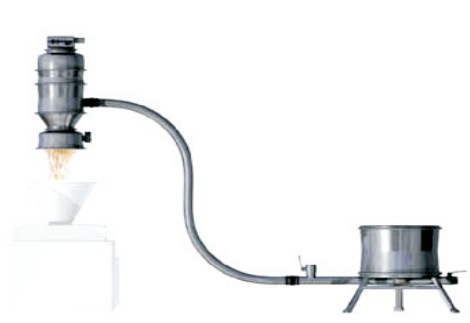

Fig1.1- pneumatic conveying system

1.1Pneumatic conveying equipment serving the following industries:

Plastics

The automation of plastics processes such as plastics extrusion, compounding and resin manufacturing can be done with pneumatic conveying equipment specifically engineered for systems in the plastics industry such as scaling, in-plant pressure conveying, in-plant vacuum conveying, vacuum sequencing and rail unload.

Chemical and Mineral

pneumatic systems can be used for conveying materials such as calcium carbonate, copper-hydroxide, talc, bentonite clay, kaolin clay, soda ash, limestone, sodium-benzoate, burnt wood chips, clay/carbon blend, gypsum, vanadium-pentoxide, dolocron, dicalcium-phosphate, silica, TiO2, lead oxide, ammonia- sulfate and boric acid.

Food & Pet Food

Within the food industry, pneumatic systems have served numerous applications including tortillas, bread and cake mixes, pasta, rice, snack food, cereal, candy, cookies and crackers, ice cream, pet food and more.

Pharmaceutical / Nutraceutical

pneumatic conveying equipment for several

pharmaceutical applications when conveying delicate materials such as tablet granulations, active pharmaceutical ingredients (APIs), excipients, and even finished capsules and tablets can be used.
1.2 General components which can be used in pneumatic conveying systems for the performance and enhancement of the system

Airlock Rotary Valves

These are the rotary valves used for separation of conveyed material from the conveying air.

Blower Packages

Blower packages are used for creating vacuum and/or pressure in conveying systems. Selecting the right blower that operates at the correct speed is critical to the success of any pneumatic conveying system.

Cyclones

With material suitable for cyclonic separation, cyclones prove to be effective as filterless pneumatic receivers. Cyclones have no moving parts, no bags to clean and and plant air and electricity are not needed for operation.

1.3Design Considerations for Pneumatic Conveying System :

Pneumatic conveying system(1) is a conventional material handling system like belt conveyor or chain conveyor. The main advantage of pneumatic conveying system is that material is transferred in close loop, thereby preventing the environmental effect on the material and vice versa. In these paper different parameters like air velocity, pressure, particle size and shape, distance to be conveyed, which govern the design of the system, are described. The research work carried out on the pneumatic conveying system in the last decade considering these parameters is also presented. No standard procedure is available for the design of pneumatic conveying system. As the configuration of the system changes, variable involved also changes, and one has to change the design considerations based on the applications. So there is wide scope for experimentation in the field of pneumatic conveying system.

1.4 Pneumatic Conveying Systems

A pneumatic conveying system is a process by which bulk materials of almost any type are transferred or injected using a gas flow as the conveying medium(2) from one or more sources to one or more destinations. Air is the most commonly used gas, but may not be selected for use with reactive materials and/or where there is a threat of dust explosions. A well designed pneumatic conveying system is often a more practical and economical method of transporting materials from one point to another than alternative mechanical systems (belt conveyors, screw conveyors, vibrating conveyors, drag conveyors and other methodologies) because of three key reasons: First, pneumatic systems are relatively economical to install and operate Second, pneumatic systems are totally enclosed and if required can operate entirely without moving parts coming into contact with the conveyed material. Being enclosed these are relatively clean, more environmentally acceptable and simple to maintain. Third, they are flexible in terms of rerouting and expansion. A pneumatic system can convey a product at any place a pipe line can run.The design procedure of pneumatic conveying system along with the formulae of various pressure drop are mentioned in this paper.

1.5 Application of dilute phase pull push type pneumatic conveying system for convening of powdered and granular material

Pneumatic conveying is a material transportation process, in which bulk particulate materials are moved over horizontal and vertical distances (3)within a piping system with the help of a compressed air stream. Pneumatic conveying is a very practical method for in-plant distribution of large amounts of dry powdered, granular, and pelletized materials. Using either positive or negative pressure of air or other gases, the material to be transported is forced through pipes and finally separated from thecarrier gas and deposited at the desired destination. The main advantage of pneumatic conveying system is that material is transferred in close loop, thereby preventing the environmental effect on the material and vice versa. No standard procedure is available for the design of pneumatic conveying system. As the configuration of the system changes, variable involved also changes, and one has to change the design considerations based on the applications. So there is wide scope for experimentation and analysis in the field of pneumatic conveying system. In this paper experimental analysis of pull push type of pneumatic system using reciprocating compressor and centrifugal blower is presented.

1.6 Choose the Right Vacuum Pump

The need to operate under vacuum (4)is widespread throughout the chemical process industries (CPI). Distillation, drying, flash cooling, stripping, and evaporation are among the unit operations that frequently take place at less than atmospheric pressure. In many process applications, the overriding consideration is the amount of vacuum (or degree of evacuation) required. Of the five major types of vacuum producing devices discussed here, the ejector can achieve the greatest degree of evacuation: down to 5 micrometers of Hg absolute. Dry pumps and rotary piston pumps can each evacuate to 10micrometers Hg; once-through oil pumps can reach 500 micrometers Hg; and liquid ring pumps can go down to 10 mm Hg. Aside from its vacuum producing ability, each of the five types has its own set of attractions and drawbacks. Many of these depend on the particular application.

1.7 Selection of pumps for process industries

Proper pump for the right process is the cornerstone of the process industry(5), where selection of a pump for smooth functioning of the machinery is vital. Nowadays it is trend to build larger and larger plants with high capacity and more reliable rotating equipment. Pump being rotating equipment. Pump being rotating equipment plays a very important role in process industries and no plant can be operated successfully without reliable and low energy efficient pumping system. The profits of the plant or

company depend upon more reliable and efficient pumping system. The heart of most process industry is the pump, because in almost all the process industry liquid is to be handled to and fro through various vessels, storage tanks, heights and lengths during the process of operation. In process industries, the liquid handled can be broadly classified as the acid, alkali and neutral with different liquid characteristics, etc.

Selection of right type of pump for different fluid and operating conditions can be daunting because of the large number of options to fit various operating conditions.

1.8 Problem with other conveyors

—In open conveying systems, there is a risk of environmental degradation.
—Very high mass flow rate cannot be obtained.
—Large area is required for setup.
—Maintenance cost is high.
—Noisy in operation
—Dried chilies can make the environment unfriendly to the workers if it is conveyed in an open conveyor.

1.9 Why pneumatic conveying?

No effects of environment on material and vice -versa because material is transported in a closed loop.
Complete automation of the process is possible hence less labour required.
More economic than chain or belt conveying systems.
Easily controllable conveying characteristics.
Increases productivity in many ways.
Lesser floor space required.
Very high mass flow rate can be obtained.

We are required to design a conveying system for dried red chilies in order to automate the process of feeding the grinder in the food processing industries at a predetermined specific mass flow rate at a certain horizontal and vertical distance, preventing the adverse effects of the environment on the material which is to be conveyed and vice-versa. Also the economy of the process is to be kept under consideration. Thus we have to design an optimum conveying system for the transfer of the material keeping in view the above mentioned requirements.

2.PNEUMATIC CONVEYING SYSTEMS

A pneumatic conveying system is a process by which bulk materials of almost any type are transferred or injected using a gas flow as the conveying medium from one or more sources to one or more destinations. Air is the most commonly used gas, but may not be selected for use with reactive materials and/or where there is a threat of dust explosions.

A well designed pneumatic conveying system is often a more practical and economical method of transporting materials from one point to another than alternative mechanical systems (belt conveyors, screw conveyors, vibrating conveyors, drag conveyors and other methodologies) because of three key reasons:

1. First, pneumatic systems are relatively economical to install and operate
2. Second, pneumatic systems are totally enclosed and if required can operate entirely without moving parts coming into contact with the conveyed material. Being enclosed these are relatively clean, more environmentally acceptable and simple to maintain
3. Third, they are flexible in terms of rerouting and expansion. A pneumatic system can convey a product at any place a pipe line can run.

Pneumatic conveying can be used for particles ranging from fine powders to pellets and bulk densities of 16 to 3200 kg/m3 (1 to 200 lb/ft3). As a general rule, pneumatic conveying will work for particles up to 2 inches in diameter @ typical density. By "typical density" we mean that a 2 inch particle of a polymer resin can be moved via pneumatic conveying, but a 2 inch lead ball would not.

2.1 Air-activated gravity conveying

This method of pneumatic conveying uses a film or cushion of air to move items such as cans, boxes, or plastic containers through a plant. Used primarily in the packaging industry, air film conveying usually requires fan static pressures of no more than 8" WG. In most cases, the system utilizes several smaller fans as opposed to one large fan.

Because the air is clean, various fan types can be used in these systems, including backwardly inclined and radial-bladed designs. Selection is based on pressure and flow, but configuration is equally important.

Either positive pressure or vacuum can be used to move the containers. In a pressurized system, air is directed through a drilled or slotted surface, where the air is discharged at a slight angle in the direction of flow. The greater the discharge angle, the higher the velocity from one station to the next. Vacuum elevators are used to raise or lower containers to different levels in the system by holding them to a moving, perforated belt. Vacuum transfer devises allow fallen or damaged product to drop out of the system, thereby reducing downtime and maintaining efficient high-speed processing. Both techniques may be employed in different portions of complex conveying systems.

The benefits of air film conveying over conventional mechanical conveying include:
1. Increased process speed
2. Lower maintenance costs (fewer moving parts)
3. Reduced energy consumption
4. Reduced downtime from jamming
5. Gentler handling of the product

Many companies in the packaging industry use a combination of air and mechanical conveying systems in their manufacturing processes

New Concept for conveying chili:

The working of the system is quite easy to understand. The vacuum generator creates a negative pressure inside the suction chamber and the pressure outside is equal to that of the atmosphere. Due to this pressure difference, the air from the atmosphere rushes into the suction chamber and carries the material which is to be

conveyed in the way along. The filter unit does not allow the material to enter the vacuum generator and thus it separates the material from the air. The air escapes through the exhaust and the material gets collected in the tank. When the butterfly gate is opened the material is delivered from the bottom of the tank and in this way the material is conveyed from the source to the destination.

Fig . Pneumatic conveying system

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