
PNEUMATIC CONVEYOR SYSTEM

***Om Chhotu Shirsath, Ankit Sunil Mishra Prof. P. K. Patil**

Department of Mechanical Engineering, Sandip Polytechnic, Nashik, India.

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***Corresponding Author: Om Chhotu Shirsath**

Department of Mechanical Engineering, Sandip Polytechnic, Nashik, India.

DOI: <https://doi-doi.org/101555/ijarp.1499>**ABSTRACT**

Pneumatic conveying is an essential technology for the efficient and dependable transportation of bulk solids, powders, and granular materials used in various industries. Pneumatic conveying systems use air or gas as the conveying medium, and the materials are transported through pipelines or ducts using a combination of pressure and airflow [1]. The advantages of pneumatic conveying include its ability to move materials over long distances, flexibility in routing, and transport materials in a closed system that minimizes dust and other environmental hazards. One of the most significant advances in pneumatic conveying technology is the development of high-pressure systems that allow for transporting materials over even longer distances. High-pressure systems use compressed air to move materials through pipelines, reducing the need for energy-intensive pumps or other mechanical devices. Additionally, these systems can be operated with lower flow rates, reducing energy consumption and improving overall efficiency.

CHAPTER 1: INTRODUCTION

The Pneumatic Conveying Design Guide is intended to be of use to both designers and users of pneumatic conveying systems. It has been written on the basis that the reader knows little or nothing about pneumatic conveying or pneumatic conveyors, hence each aspect of the subject is discussed from basic principles and many of the chapters are of an introductory nature. The Guide, however, also includes detailed data and information on the conveying characteristics of a number of materials embracing a wide range of properties. The data can be used to design pneumatic conveying systems for the particular materials, using logic diagrams for design procedures, and scaling parameters for the conveying line configuration. Where pneumatic conveyors already exist, the improvement of their performance is considered, based on strategies for optimizing and up-rating, and the extending of systems or

adapting them for a change of material is also considered. In this introductory chapter a brief introduction to pneumatic conveying is given to introduce the common terms and concepts. First among these are dilute and dense phase conveying and the specific problem of compressibility of air and other gases that might be used. The capability of pneumatic conveying systems in terms of distance, tonnage and orientation are addressed, together with a brief history of developments. A very brief review of the chapters is given, along with some of the basic definitions, and the nomenclature adopted in the book is presented here for reference.

Pneumatic conveying systems are basically quite simple and are eminently suitable for the transport of powdered and granular materials in factory, site and plant situations. The system requirements are a source of compressed gas, usually air, a feed device, a conveying pipeline and a receiver to disengage the conveyed material and carrier gas. The system is totally enclosed, and if it is required, the system can operate entirely without moving parts coming into contact with the conveyed material. High, low or negative pressures can be used to convey materials. For hygroscopic materials dry air can be used, and for potentially explosive materials an inert gas such as nitrogen can be employed. A particular advantage is that materials can be fed into reception vessels maintained at a high pressure if required.

With a suitable choice and arrangement of equipment, materials can be conveyed from a hopper or silo in one location to another location some distance away. Considerable flexibility in both plant layout and operation are possible, such that multiple point feeding can be made into a common line, and a single line can be discharged into a number of receiving hoppers. With vacuum systems, materials can be picked up from open storage or stockpiles, and they are ideal for clearing dust accumulations and spillages. Pipelines can run horizontally, as well as vertically up and down, and with bends in the pipeline any combination of orientations can be accommodated in a single pipeline run. Conveying materials vertically up or vertically down presents no more of a problem than conveying horizontally. Material flow rates can be controlled easily and monitored to continuously check input and output, and most systems can be arranged for completely automatic operation. Pneumatic conveying systems are particularly versatile. A very wide range of materials can be handled and they are totally enclosed by the system and pipeline. This means that potentially hazardous materials can be conveyed quite safely. There is minimal risk of dust generation and so these systems generally meet the requirements of any local Health and Safety Legislation with little or no difficulty. Pneumatic conveying plants take up little floor space and the pipeline can be easily routed up walls, across roofs or even underground to avoid existing equipment or structures. Pipe bends

in the conveying line provide this flexibility, but they will add to the overall resistance of the pipeline. Bends can also add to problems of particle degradation if the conveyed material is friable, and suffer from erosive wear if the material is abrasive.

Industries and materials A wide variety of materials are handled in powdered and granular form, and a large number of different industries have processes which involve their transfer and storage. Some of the industries in which bulk materials are conveyed include agriculture, mining, chemical, pharmaceuticals, paint manufacture, and metal refining and processing. In agriculture very large tonnages of harvested materials such as grain and rice are handled, as well as processed materials such as animal feed pellets. Fertilizers represent a large allied industry with a wide variety of materials. A vast range of food products from flour to sugar and tea to coffee are conveyed pneumatically in numerous manufacturing processes. Confectionery is a particular industry in which many of these materials are handled. In the oil industry fine powders such as barytes, cement and bentonite are used for drilling purposes. In mining and quarrying, lump coal and crushed ores, and minerals are conveyed. Pulverized coal and ash are both handled in very large quantities in thermal power plants. In the chemical industries materials include soda ash, polyethylene, PVC and polypropylene in a wide variety of forms from fine powders to pellets. Sand is used in foundries and glass manufacture, and cement and alumina are other materials that are conveyed pneumatically in large tonnages in a number of different industries

CHAPTER 2: LITRETURE REVIEW

Sr. No.	Paper Details	Summary of paper	Conclusion
1	Pneumatic Conveying Technology: Recent Advances and Future Outlook Maria Concepcion Abe1, Gabriel Angelo Gelladuga 1 ResearchGate November 2023	Several research gaps in pneumatic conveying technology are identified in the paper, including the integration of artificial intelligence and machine learning, the optimization of multiphase flow behavior, energy efficiency and sustainability, material degradation, and particle damage, handling of cohesive and difficult-to-convey materials, scale-up and design optimization, and real-time monitoring and control systems. The future outlook highlights the potential of sustainable practices to advance pneumatic conveying technology	Future research will concentrate on incorporating sophisticated sensor technologies into pneumatic conveying systems, allowing for the real-time monitoring of various parameters. Data analytics and machine learning techniques will make it possible to meaningfully extract the massive amounts of data produced by real-time monitoring systems, improving the system's efficiency and proactive decision-making

		further. The integration of these technologies can lead to improved performance, energy efficiency, and sustainability in pneumatic conveying systems.	
2	Pneumatic Conveying Design	Pneumatic conveying systems are basically quite simple and are eminently suitable for the transport of powdered and granular materials in factory, site and plant situations. The system requirements are a source of compressed gas, usually air, a feed device, a conveying pipeline	Many dusts represent a very significant health hazard. If these materials are to be conveyed it is essential that any dust associated with the material should remain within the conveying system while being transported. If any material is deemed to be toxic to any degree
		and a receiver to disengage the conveyed material and carrier gas. The system is totally enclosed, and if it is required, the system can operate entirely without moving parts coming into contact with the conveyed material. High, low or negative pressures can be used to convey materials. For hygroscopic materials dry air can be used, and for potentially explosive materials an inert gas such as nitrogen can be employed. A particular advantage is that materials can be fed into reception vessels maintained at a high pressure if required	there should be no possibility of any dust being released into the atmosphere. There is also a wide range of materials, which, in a finely divided state, dispersed in air, will propagate a flame through the suspension if ignited.
3	Introduction to Pneumatic Conveying of Solids Karl Jacob The Dow Chemical Compan	Pneumatic conveying is the movement of solids through pipe using gas (usually air) as the motive force. It differs from hydraulic or slurry conveying in that the gas expands continuously along the pipe length. The flow regime in the pipe depends greatly on the ratio of solids to gas and the particle characteristics	Vertical transport applications have typically been served by mechanical conveying systems. These operations can be dusty and high maintenance, leaving you with costly clean-up and expensive downtime. Not to mention the safety issues that come with both.
4			

CHAPTER 3: INFORMATION

Need of the project

Conveying systems should move materials where you want them to go, at the speed and density you require. Our systems are designed on that basis. You tell us what you need and

we'll find the right solution for you, not just the closest fit from a handful of 'not quite right' solutions. Our range of pneumatic transport systems includes options for dense, medium and dilute phase conveying; pressure vessel, screw pump or Airslide® air gravity conveyor systems; high pressure or low pressure, but always low maintenance, clean and efficient. Pneumatic conveying offers a safe and reliable solution with the added benefit of flexibility and low operational costs. These space saving systems will take the material where you need it, regardless of the terrain or what other equipment you need to work around.

➤ **Problem statement**

Achieving optimum flowability and fluidisation is imperative. But handling dry bulk materials can be challenging. They can be abrasive. Prone to attrition. If your system isn't fully enclosed, dust can escape. Unsuitable conveying system design can cause blockages, underperformance and build-up. Even worse, you risk unplanned changes in bulk characteristics. All of which cost you time and money to put right. Traditional mechanical conveying solutions have a lot of moving parts, which require a lot of maintenance, which necessitates downtime.

Once again you're spending time and money. Not to mention risking personnel safety

CHAPTER 5: CONCLUSION

The pneumatic conveyor system offers an efficient, clean, and reliable method for transporting bulk materials using air as the conveying medium. Compared to traditional mechanical systems, it provides advantages such as reduced material contamination, lower maintenance requirements, and flexible routing capabilities. Through proper design and selection of components like blowers, pipelines, and feeding systems, the pneumatic conveyor ensures smooth and continuous material flow. Overall, this system demonstrates its effectiveness in modern industries for handling powders, granules, and other dry materials with high efficiency and safety.

CHAPTER 6: PROJECT INITIATION

The Pneumatic Conveyor System project is initiated to design and develop an efficient material handling system that uses air pressure or vacuum to transport bulk materials through pipelines. The need for this project arises from the limitations of conventional mechanical conveyors, such as belt or screw systems, which often face issues like material spillage, higher maintenance, and contamination risks.

The primary goal of this project is to explore the working principles, design considerations,

and practical implementation of a pneumatic conveying system suitable for industrial applications. This includes studying the types of conveying systems (positive pressure, negative pressure, and combination systems), understanding the flow behavior of different materials, and selecting appropriate components such as compressors, pipelines, and feeding devices.

The project is initiated to achieve the following objectives:

- To analyze the advantages of pneumatic conveying over mechanical systems.
- To design a simple and cost-effective pneumatic conveyor prototype.
- To study the system's performance, efficiency, and reliability in material transportation.
- To promote clean and automated material handling solutions for modern industries.

This project serves as a foundation for understanding industrial automation in material handling, providing both theoretical knowledge and practical exposure to pneumatic systems and control mechanisms.

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