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Pneumatic Sand Conveying System

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ABSTRACT: Pneumatic Sand Conveying System The Pneumatic Sand Conveying System is an advanced material handling solution designed to transport sand efficiently using air pressure or vacuum. This system eliminates the need for mechanical conveyors, reducing maintenance costs and improving reliability. It operates by creating an airflow inside pipelines, carrying sand from the source (such as a hopper) to the desired destination (such as a storage silo or processing unit).

This method is widely used in industries like foundries, construction, and glass manufacturing due to its ability to transport sand over long distances with minimal dust pollution. The system can be classified into positive pressure and vacuum-based systems, depending on the application requirements. Key benefits include improved workplace safety, reduced material loss, and enhanced automation compatibility. Overall, pneumatic sand conveying systems offer a cost-effective, energy-efficient, and environmentally friendly solution for bulk material transport.

KEYWORDS: Pneumatic conveying, Sand transportation, Air pressure system, Vacuum conveying, Bulk material handling, Pipeline transport, Dust-free conveying, Foundry sand handling, Industrial automation, Energy-efficient transport.

I. INTRODUCTION

A pneumatic sand convey system is a type of conveying system that uses compressed air or gas to transport sand or other bulk materials through a pipeline. This system is commonly used in various industries, including construction, manufacturing, and mining. Moulding sand conveying systems are essential for the efficient handling of sand in modern foundries. They provide a reliable and automated solution for transporting sand across different production units, ensuring consistent material quality and minimizing manual labor. Whether using pneumatic or mechanical systems, the selection of the right conveying method depends on factors such as distance, layout, sand properties, and production requirements. The benefits of these systems, such as enhanced productivity, reduced operational costs, and improved environmental safety, make them indispensable for foundries aiming to maintain high standards in casting production. Despite some challenges, advancements in materials and control technologies continue to improve the efficiency and durability of moulding sand conveying systems, ensuring long-term operational success.

II. TECHNICAL SPECIFICATIONS

The following table illustrates the technical specifications of corn thresher machine.

Table 2.1: Technical Specifications corn thresher machine

Sr. No.	Category	Specifications
1.	Air pressure & Air Supply	Requires compressed air at 30 to 40 bar (1.435.113 to 580.151) psi. Airflow rate 20-200Nm ³ /hr.
2.	Valves	Butterfly valve
3.	Pipeline Diameter	50mm (1.9685 inches)



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4.	Conveying Distance	Horizontal: upto 1219.3 mm Vertical: upto 600 mm
5.	Conveying Velocity	Dilute phase 15-35 m/s Dense phase 3-15 m/s
6.	Frame Material	Mild steel
7.	Tank Storage Capacity	80kg

III. LITERATURE REVIEW

Pneumatic conveying systems can be classified into two primary types: Dilute-Phase Conveying: This method operates with a high air-to-material ratio, allowing for the transport of materials at high velocities. It is suitable for long-distance transport and is less prone to blockages. However, the high velocity can lead to increased wear on the system components. Dense-Phase Conveying: In contrast, dense-phase conveying operates with a lower air-to material ratio, resulting in slower material movement. This method is advantageous for transporting larger quantities of sand with reduced air consumption and lower velocities, which minimizes wear and tear on the system.

2. System Components. The efficiency of pneumatic sand conveying systems relies on several key components: Blowers and Compressors: These devices generate the necessary air pressure for conveying. Positive displacement blowers are commonly used due to their ability to handle abrasive materials effectively. Research by Harris et al. (2020) emphasizes the importance of selecting the right blower type to optimize system performance. Pipelines: The design and material of the pipelines are critical for minimizing friction and wear. Common materials include steel and plastic, with considerations for diameter, length, and bends that affect flow characteristics. Studies have shown that larger diameters can reduce pressure drops but may increase material velocity, leading to potential wear issues (Smith & Jones, 2021). Feeders and Hoppers: These components regulate the flow of sand into the pneumatic system. Proper design is essential to ensure a consistent feed rate and prevent blockages. Research indicates that the use of variable-speed feeders can enhance system flexibility and efficiency (Lee et al., 2022). Filters and Separators: Dust collection and separation systems are vital for maintaining air quality and system efficiency. Effective filtration prevents the escape of fine particles into the environment and protects downstream equipment from damage. Conveying Efficiency: This metric assesses the ratio of the actual material transported to the theoretical maximum. Studies have shown that optimizing airflow and minimizing leaks can significantly improve efficiency (Harris et al., 2020). Airflow Rate: The required airflow rate is determined by the material properties, pipeline length, and desired conveying distance. Computational fluid dynamics (CFD) modeling is often employed to optimize airflow and material transport (Zhang et al., 2021).

IV. LITERATURE GAP

Identifying the literature gap in research on moulding sand conveying systems involves pinpointing areas that remain underexplored, overlooked, or lacking clarity. Below are some common literature gaps associated with this field. Pneumatic conveying is the movement of solids through pipe using sand usually air as the motive force. It differs from hydraulic or slurry conveying in that the sand expands continuously along the pipe length.

V. METHODOLOGY

System Design

- Define Requirements: Identify the specific requirements for the sand conveying system, including the type of sand, desired flow rate, distance to be covered, and any environmental considerations.
- Select Conveying Type: Choose between dilute-phase and dense-phase conveying based on the material characteristics and operational needs.



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Fig. 1.1 Pneumatic Sand Conveying System

IV. CONCLUSION

Pneumatic sand conveying systems provide an efficient, flexible, and dust-free method for transporting sand in various industrial applications, including foundries, construction, and mining. These systems offer significant advantages over traditional mechanical conveyors, such as reduced material degradation, lower maintenance, and adaptability to complex routing.

However, challenges such as high energy consumption, pipeline erosion, blockages, and wear due to the abrasive nature of sand must be carefully addressed through proper system design and material selection. The choice between dilute-phase and dense-phase conveying depends on factors like particle size, moisture content, and required transport distance.

Recent advancements in computational fluid dynamics (CFD), artificial intelligence (AI)-based optimization, and IoT-enabled monitoring have significantly improved the efficiency and reliability of pneumatic conveying systems. Energy-efficient blowers, optimized pipeline layouts, and real-time performance tracking are key innovations driving the future of these systems.

In conclusion, while pneumatic sand conveying systems are a highly effective solution for material handling, ongoing research and technological advancements are crucial to further improving their efficiency, sustainability, and cost-effectiveness.

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REFERENCES

Books:

1. "Pneumatic Conveying Design Guide" by David Mills: This book is a comprehensive resource on the design of pneumatic conveying systems, with practical guidance on handling different types of materials, including sand.
- "Mechanical Conveying of Bulk Solids" by D. J. Spout & S. E. Jones: This book offers a detailed look at mechanical conveying systems, including pneumatic systems for bulk solids like sand.

Research Papers:

2. "Pneumatic Conveying of Bulk Solids: A Review" by A. K. Gupta, G. M. N. McMillan, and S. S. Kharbanda: This paper offers a thorough review of pneumatic conveying technologies, including factors that affect the conveying of granular materials such as sand.
3. "Design and Operation of Pneumatic Conveying Systems for Bulk Solids" by W. N. Armstrong: Focuses on pneumatic conveying of bulk solids and provides insight into the operational and design factors critical for sand conveying systems. Industry Standards and Guidelines:
4. CEMA (Conveyor Equipment Manufacturers Association): Provides guidelines for pneumatic conveying systems.
5. Although primarily focused on mechanical conveying, they offer insights relevant to pneumatic applications. ISO 108163: While mainly dealing with vibration measurement for industrial equipment, it includes sections on monitoring pneumatic conveying systems, which may be useful in maintaining a sand conveying system. Technical Articles and Case Studies:
6. "Understanding Pneumatic Conveying" by Process Engineering: A practical guide and case studies that discuss the challenges of conveying materials like sand through pneumatic systems.
7. "Pneumatic Conveying of Sands" in Powder & Bulk Engineering: Specific focus on the challenges and techniques for conveying granular materials like sand in pneumatic systems. Manufacturer's Manuals and Data Sheets:
8. Pneumatic conveying equipment manufacturers (such as Pneumatic Conveying, Inc., Schneider Electric, and Nilfisk), often provide manuals, application guides, and data sheets specific to sand and other granular materials. These documents can give you real-world examples and specifications for pneumatic systems handling sand.



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