

Designing Pneumatic Conveying Systems for Food Safety and Sanitary Compliance



Pneumatic conveying is widely used in food processing because it enables enclosed, efficient transfer of powders and bulk solids. However, in sanitary environments, system design directly impacts food safety, cleanability, and regulatory compliance.

A poorly designed system can introduce contamination risks that are difficult to correct after installation. For that reason, sanitary considerations must be addressed at the earliest stages of design.

Understanding the Risk Profile

Unlike open mechanical systems, pneumatic conveying operates within a closed pipeline. While this reduces external contamination, it increases reliance on the internal condition of the system.

Material buildup, residual products, and inaccessible areas can all become sources of cross-contamination. These risks are especially pronounced in facilities handling allergens, dairy products, or hygroscopic ingredients.

Design decisions that seem minor such as pipe routing or connection type can have a measurable impact on cleanability and product safety.

Material Selection and Surface Finish

All product-contact surfaces must be selected with both durability and sanitation in mind. Stainless steel is typically used for its corrosion resistance and compatibility with cleaning processes. Just as important is the internal surface finish. Rough or irregular surfaces promote product adhesion, particularly with fatty or moisture-sensitive materials.

Connections should be designed to minimize crevices and eliminate areas where material can accumulate. Even small inconsistencies can become long-term contamination risks in food applications.

System Layout and Product Retention

System layout plays a critical role in preventing product retention.

Horizontal runs, abrupt transitions, and tight-radius bends can all create areas where material settles out of the airstream. Over time, this buildup can lead to contamination, inconsistent flow, or microbial growth.

Designing for consistent velocity and smooth transitions helps ensure that material remains in motion throughout the system and is fully conveyed during operation.

Air Quality and Process Control

In pneumatic conveying, air is not just a transport medium, it is part of the process environment.

Compressed air must be clean, dry, and free of oil. Inadequate filtration or moisture control can introduce contamination or cause product clumping within the line. Monitoring dew point and maintaining proper filtration are essential, particularly in applications involving powders that readily absorb moisture.

Cleanability and System Access

Cleaning requirements vary significantly depending on the product and process.

Dry cleaning methods are often preferred for materials such as flour, sugar, or spices, where water introduction is undesirable. These systems may use air purging or mechanical methods to remove residual product between runs.



In contrast, wet cleaning or clean-in-place (CIP) systems are necessary in applications with stricter hygiene requirements, such as dairy or allergen-sensitive production. These systems must be designed with proper drainage, slope, and drying capability to prevent residual moisture.

Regardless of the method, access for inspection and validation is critical. A system that cannot be effectively cleaned cannot be reliably validated.

Managing Product Integrity

Sanitary design must also account for how the product behaves during conveying.

Excessive velocity or pressure can lead to particle degradation, particularly in fragile or agglomerated materials. In these cases, dense phase conveying or carefully controlled air velocities may be required to preserve product quality while maintaining sanitary conditions.

Documentation and Compliance

Regulatory compliance extends beyond physical design. Documentation of materials, finishes, and cleaning procedures is essential for validation and audit readiness.

Facilities operating under FSMA or GFSI frameworks must be able to demonstrate that their conveying systems support hygienic design principles and can be effectively cleaned and maintained.

Final Thought

Pneumatic conveying systems are often viewed as utility infrastructure, but in food processing they are part of the production environment. Designing with sanitation, cleanability, and product behavior in mind is essential to achieving both compliance and consistent performance.

About Hapman

Hapman is a U.S.-based manufacturer of bulk material handling equipment with more than 80 years of experience supporting food processors and other industries. From bulk bag unloading to pneumatic conveying, Hapman systems are designed to improve material flow, reduce product loss, and support sanitary operations.

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