APPLICATION GUIDE

Modernizing Reactor Charging with Dense-Phase Vacuum Conveying

How the De Dietrich Powder Pump System improves containment, operator safety, and batch performance.

Overview

Charging powders into reactors is one of the most common—and often one of the most challenging—steps in batch manufacturing. Whether producing specialty chemicals, pharmaceuticals, fine chemicals, or other high-value products, manufacturers must safely transfer dry bulk solids into vessels while maintaining product quality, protecting operators, and preserving critical process conditions.

For many facilities, this operation is still performed manually by opening the reactor manway and charging powders directly into the vessel. While familiar, this approach can introduce safety risks, housekeeping challenges, inconsistent material addition, and loss of containment.

This application guide highlights common reactor charging challenges encountered across multiple industries and demonstrates how De Dietrich's Powder Pump systems have helped facilities improve safety, containment, and overall process performance.

Typical Applications

Although every manufacturing process is unique, the objectives of reactor charging are remarkably consistent. The examples presented throughout this guide represent installations across several industries where powders are routinely introduced into reactors or mixing vessels.

Typical applications include:

- Specialty chemical manufacturing
- Pharmaceutical production
- Fine chemical processing
- Pilot plants and research laboratories
- Batch manufacturing operations requiring contained powder transfer

Many of these applications involve charging powders into vessels containing solvents, operating under vacuum, or maintained under an inert nitrogen atmosphere, making containment and controlled material transfer critical to both safety and process performance.

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Common Reactor Charging Challenges

Although products and processes vary, the challenges surrounding manual reactor charging are often very similar.

Protecting Operators

Opening reactor manways exposes operators to both the product being charged and, in many cases, the process occurring inside the vessel. Depending on the application, operators may encounter airborne dust, hazardous materials, solvent vapors, ergonomic risks associated with lifting heavy bags, or the potential for combustible dust hazards.

Improving Process Consistency

Manual charging relies heavily on operator technique. Feed rates, charging times, and material addition often vary between operators and batches, creating unnecessary process variability.

Maintaining Process Integrity

Many batch processes require reactors to remain under inert conditions or vacuum throughout production. Opening the vessel during charging can introduce oxygen, moisture, or contaminants that may negatively impact both product quality and process safety.

Reducing Housekeeping Requirements

Open powder handling frequently results in spills, dust accumulation, and material loss. Besides increasing cleanup requirements, poor containment can affect overall plant cleanliness and employee exposure.

Engineering Considerations

Successfully improving reactor charging requires more than replacing manual handling with automation.

Engineers must evaluate a variety of application-specific considerations, including:

- Powder flow characteristics
- Reactor operating pressure and temperature
- Solvent compatibility/materials of construction
- Containment requirements
- Inert gas management
- Batch size and transfer rate
- Facility layout
- Operator interaction
- Integration with existing process controls

These factors determine the most appropriate conveying approach while ensuring safe, repeatable operation.

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The De Dietrich Solution

To address these challenges, De Dietrich applies dense-phase vacuum conveying technology via the Powder Pump to create a fully enclosed reactor charging system.

Rather than opening the reactor manway, powders are transferred directly from drums, bags, bulk bags, or other source containers through a closed conveying system into the reactor. Throughout the transfer cycle, containment is maintained while minimizing operator exposure and preserving critical process conditions.

The Powder Pump system utilizes an automated sequence of vacuum, isolation, inerting, and discharge cycles to transfer material safely and consistently. Because the process is fully automated, powder addition becomes significantly more repeatable than traditional manual charging methods while supporting operation under inert atmospheres, vacuum, or pressure.

Examples of Reactor Charging Applications

Rather than presenting a single installation, these examples illustrate how Powder Pump systems have been successfully integrated into a variety of reactor charging applications.

EXAMPLE 1

Speciality Chemical Manufacturing

A 4-inch Powder Pump mounted directly on a De Dietrich glass-lined reactor system used for processing an API. The Powder Pump shell in this model contains a CIP port.

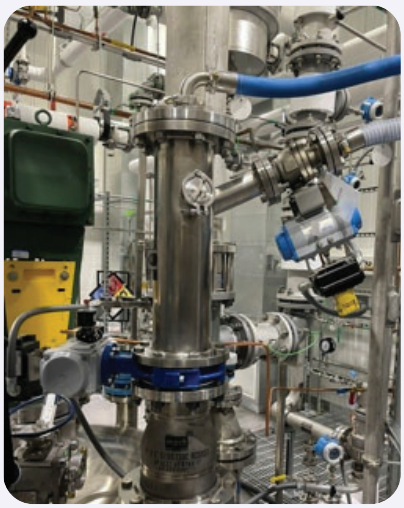
EXAMPLE 2

Research and Development Laboratory

A 4-inch Powder Pump mounted directly on a De Dietrich glass-lined reactor provides contained charging of powders from drums while maintaining process integrity.

EXAMPLE 3

Pharmaceutical Manufacturing



A Hastelloy Powder Pump system integrated with an alloy reactor supports contained transfer from a downflow booth in a highly regulated pharmaceutical process.

Conclusion

While every reactor charging application presents unique process requirements, the underlying goals remain remarkably consistent: improve operator safety, maintain containment, preserve product integrity, and create a more repeatable manufacturing process.

Rather than relying on traditional manual charging methods, manufacturers across the specialty chemical, pharmaceutical, and fine chemical industries are increasingly adopting engineered conveying solutions that address these challenges through contained, automated material transfer.

By approaching reactor charging as an engineering challenge—not simply a material handling task—facilities can reduce risk, improve process consistency, and create safer, more efficient operations.

CONTINUE EXPLORING POWDER HANDING SOLUTIONS

Discover additional resources, application examples, product information, and engineering expertise designed to help improve powder transfer, containment, and reactor charging operations.

Visit: www.ddpsinc.com/powder-handling-solutions

Benefits Achieved

Across these applications, facilities experienced several common improvements.

Improved Operator Safety

- Reduced operator exposure to powders and process vapors
- Eliminated lifting over open reactor manways
- Reduced airborne dust generation

Improved Containment

- Maintained inert atmospheres during charging
- Reduced contamination risk
- Supported charging under vacuum or pressure

Better Process Control

- Consistent material addition
- Improved batch repeatability
- Automated transfer sequencing

Increased Operational Efficiency

- Reduced manual labor
- Improved housekeeping
- Lower product loss
- Increased production consistency