# Contained Drum Unloading Increases Safety in Work Environment:

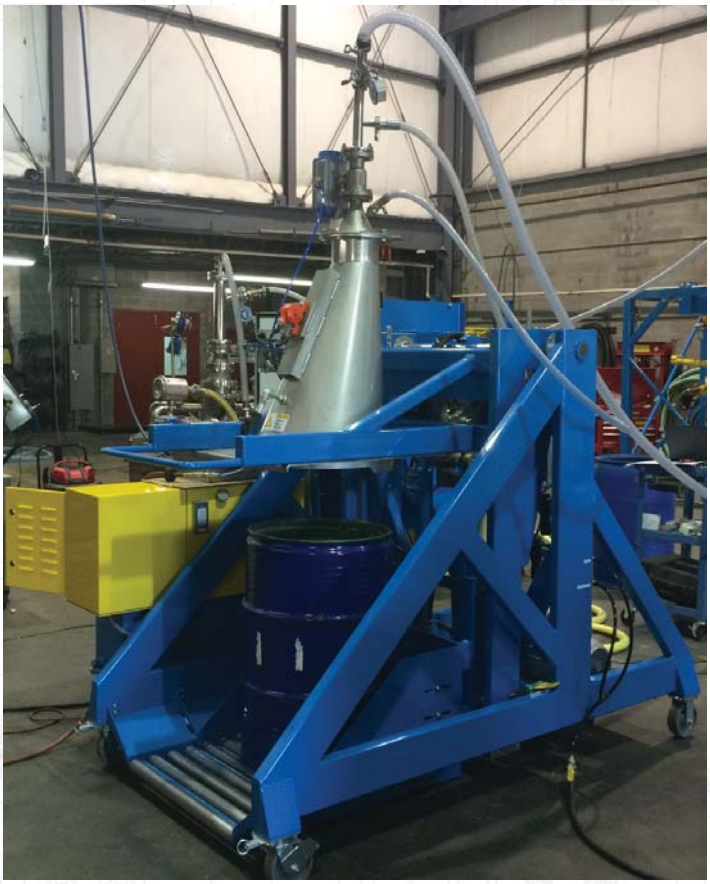
## Improved Containment Reduces Operator Exposure

## Overview

De Dietrich Process Systems' powder handling technology is most commonly used to provide a safer work environment for operators and plant personnel.

So, when we were approached by an existing customer and asked to assist them with improving containment of a highly toxic and reactive powder while charging it from drums into their reactor, we immediately set to work designing a system that would meet this primary goal, as well as several other secondary considerations.

Following factory testing, installation and start-up, the completed system met all the customer's requirements for operator safety, process control and material containment.



## About

For almost 50 years, this customer has provided innovative solutions to difficult applications involving the production of Hydrotopes, Acid Catalysts and Naphthalene Sulfonates. As with many existing chemical production facilities, they relied heavily on PPE, and "homemade" equipment to provide operator safety and material containment.

However, when a new building expansion was proposed, they recognized the opportunity to improve on those areas by installing a pneumatic transfer system to reduce physical handling of, and exposure to this material during reactor charging.

CASE STUDY

POWDER HANDLING SOLUTIONS

CASE STUDY
**Contained Drum Unloading**

POWDER HANDLING SOLUTIONS

## Challenges

The material being handled is Phosphorous Pentoxide (P205), an extremely toxic powder, even at concentrations as low as 1 mg/$m^3$. It also reacts vigorously and exothermically when exposed to moisture, resulting in high reaction temperatures which can degrade the quality of the final product. Also, floor space in the new building was at a premium. As such, the primary challenges for the system design were, in order of importance:

1. Improved containment and operator protection during material handling.
2. Transfer from the building's ground floor to the top of the elevated reactor.
3. Monitor and control the transfer rate and reactor temperature during charging.
4. Minimize transfer system footprint.

## Solution

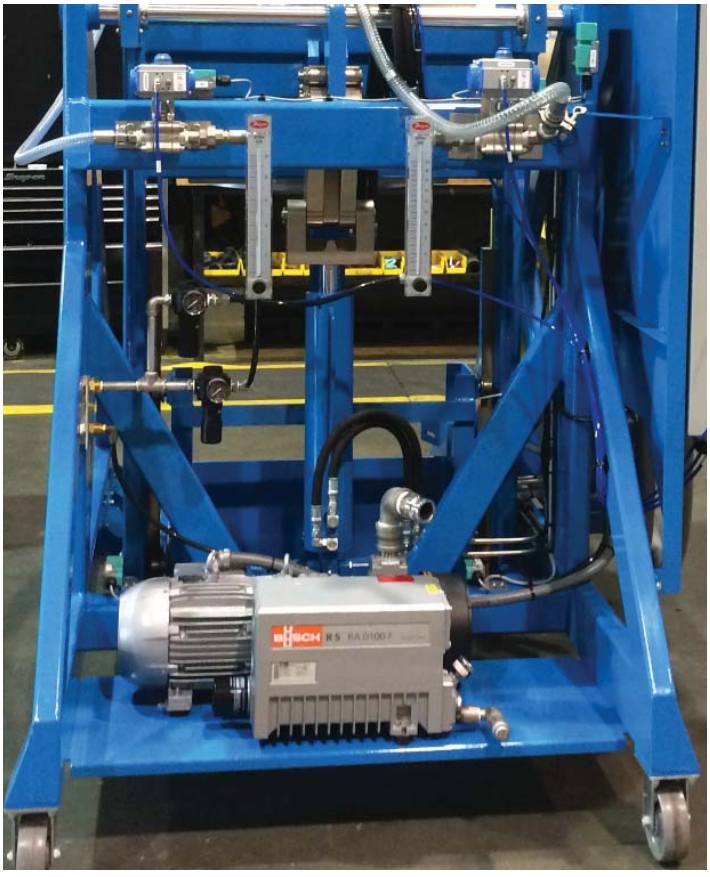
The P205 is delivered in 200 Kg metal drums. As such, a system capable of sealing a full drum, raising and inverting it to an adjustable angle, and pneumatically conveying its contents at the rate and distance required was quickly agreed upon as the simplest and most desirable solution. The final system design provided all the following.

Containment: The only time an operator is now exposed to the powder during normal operation is between the time:

A. a drum's lid is removed and the drum is sealed against the discharge cone, and
B. when the empty drum is unsealed from the discharge cone and the lid is replaced.

Now, the operator only needs to wear a PPE respirator mask during those two brief times.

*Drum loading carriage and transfer cone*



*Mobile unit with integral vacuum pump and gas flow controls*

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Transfer Distance: Due to the toxic and corrosive nature of the P2O5, it was not feasible to conduct a transfer test at DDPS' facility using this material. Therefore, a suitable surrogate test material, similar in bulk density and other characteristics was agreed upon with the client.

During Factory Acceptance Testing (FAT) at DDPS, this surrogate material was used to confirm the required transfer distance and elevation were achievable, and all other aspects of the system's design were tested for functionality and safety.

Transfer Rate: A critical requirement for the system's PLC based controls was the ability to monitor and control the material transfer rate. Too low a rate might indicate a problem with material transfer, and too high a rate could result in product quality issues.

In most cases, the drum unloading system would be supplied with a "loss-in-weight" monitoring system, including weigh cells, to measure the amount of material transferred over time. In this case however, the customer preferred to use the existing weigh cells on the reactor to measure its "gain-in-weight".

An adjustable transfer rate set-point was provided on the system's HMI screen, as well as a corresponding display of real time transfer rate. If the real time rate exceeds the desired rate, the PLC program automatically slows the transfer until the desired rate is re-established. Simultaneously, the reactor's temperature is continuously monitored and an alarm is issued if it exceeds a desired set-point.

Equipment Footprint: The drum unloading unit is located on the ground floor, occupying valuable real estate. Since the unit's footprint has a minimum required area, it was decided to make it movable so it could be stored away when not in use to free up walk-ways and production space. This required that all process and utility connections on the system be designed for quick disconnect from their source.

## Results

The DDPS supplied P2O5 transfer system significantly improved containment of this hazardous material, and freed up operators to conduct other tasks while reactor charging is occurring. Process safety, product quality, housekeeping and maintenance all benefited from this system's installation.

*PLC control and hydraulic unit cabinets*


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