Meet Process Needs Without a Custom Design

A pre-engineered vacuum conveying system can help address common challenges

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When considering a new a vacuum conveying system, what comes to mind might be an expensive custom solution that can take months of design before it reaches the plant floor. Or perhaps you imagine an older, off-the-shelf system designed for undemanding bulk solids transfer and limited powder applications.

However, today's turnkey pre-engineered vacuum conveying packages descend from a line of custom-engineered solutions and satisfy approximately 80% of the challenges faced when conveying powders and bulk solids, including combustible dust. The other 20% may need custom or auxiliary equipment to achieve an organization's material handling needs.

All vacuum conveying systems consist of five basic components: a pickup point, vacuum receiver, vacuum producer, control panel and conveying tubing — simple stuff, right? Not so fast! It's more complex because each component has a variety of options that influence the parameters of the next.

The art of vacuum conveying manifests in the careful orchestration of these components to create a system that provides application-specific solutions. Pre-engineered solutions are birthed from custom first-time solutions that advanced the science of vacuum conveying.

PRE-ENGINEERED VACUUM CONVEYING SYSTEMS

Examples of custom-engineered systems that have been adapted into application-specific, pre-engineered packaged systems include tablet press loading systems; direct-charge blender loading for food, pharmaceuticals and

chemicals; and metal powder recovery systems for additive manufacturing.

In addition to these, modern general-duty pre-engineered conveying system packages include component options for vacuum producers, conveyor mounting, standard or sanitary design, filter media possibilities, interior and exterior finishes and flexible utility alternatives to complement plant utility requirements. These package choices provide a broader range of use across the food, pharmaceutical, chemical, plastics compounding and metal forming and finishing industries and are adaptable when conditions such as business needs or materials change.

TUBE HOPPER VACUUM RECEIVERS
Figure 1. Tube hopper vacuum receivers are well-suited to vacuum convey difficult-to-convey bulk materials such as cohesive pigments, additives, fibers or similar materials that have a tendency to bridge or rathole.

SHOPPING FOR A SYSTEM

Purchasing a pre-engineered vacuum conveyor isn't like purchasing a widget from a website where you just click on a product and it ships to you. Because each organization and plant have unique requirements, consultation with a pneumatic conveying expert still is necessary to ensure a pre-engineered product will work as intended without costly surprises. Some common custom engineering requirements are related to available space, material characteristics, integration with existing equipment and level of automation desired.

Although pre-engineered vacuum conveying systems are designed to address common powder conveying challenges experienced in a range or class of materials or for materials with a range of characteristics, some powders require auxiliary or accessory equipment making that.

Fine powders with low bulk density, such as fumed silica and carbon black, present their own set of challenges. They may require more filtration and thus a larger vacuum receiver, which may be larger than what's available in a packaged system.

Nonfree-flowing powders, like those with high fat content, generally require the most equipment modifications. However, many methods are used to handle nonfree-flowing powders that are incorporated into some pre-engineered systems.

For example, specialized finishes, oversized receiver discharge openings, 70° discharge cones and coneless (straight-walled) vacuum receivers, such as the one shown in Figure 1, can help improve material flow and

eliminate the need for custom external flow promotion.

The range of available systems helps organizations reap the benefits of using vacuum conveying equipment, such as dust containment, workstation ergonomics, material segregation prevention, decreased loading and cleaning downtime, material mishandling and spill prevention and increased throughput. Sometimes, however, the level of automation needed, plant design or integration with existing equipment prevents the use of pre-engineered systems or requires incorporating auxiliary equipment with these systems.

A SYSTEM FOR EVERY APPLICATION

The key to successful powder and bulk solids processing is finding what works for your application. Sometimes, even pre-engineered systems call for more custom solutions. For example, because blenders are used across a range of industries, from food and pharmaceuticals to cosmetics and chemical blending, a direct-charge blender loading vacuum conveying system, like the one shown in Figure 2, is an ideal pre-engineered package to use when unique conditions may require more custom solutions.

Direct-charge blender loading systems are designed specifically for the direct-charge loading of blenders, mixers, reactors and any vessel capable of withstanding a vacuum. With this type of conveying system, a facility's blender or mixer acts as the primary vacuum receiver, but power sources, filters, controls and blender covers with a product inlet and vacuum outlet can be supplied as a combined package. Pre-engineered systems are equipped with a pickup wand to suck materials from vessels into the conveying line but also can accommodate feed bins, bag-dump stations or bulk bag unloaders.

When a pharmaceutical, cosmetic and flavorings toll processor needed to accommodate industry changes in the way bulk

DIRECT-CHARGE BLENDER LOADING SYSTEMS

Figure 2. Direct-charge blender loading systems work well to move many types of materials to blenders, mixers, reactors or any process vessel capable of withstanding vacuum.

materials were transported, the company found its existing method no longer worked. After researching vacuum conveying options, the processor decided that the pre-engineered direct-charge blender loading system was the ideal solution because it was designed to address specific needs of blender loading while eliminating the need for a conventional vacuum receiver and avoiding product waste.

Because many of the processor's customers provided bulk powders in 25-lb bags, using a wand to suck material from vessels into the conveying line wasn't a viable option, so the company added a bag-dump station, like the one in Figure 3, that fed material into the direct-charge blender loading system. This addition allowed operators to lift bags onto the bag-dump station grate, cut a slit in the bag and then turn the bag over so that the material would fall by gravity into the conveying line.

Ergonomic bag-dump stations reduce spillage during bag loading by using negative pressure to suck fugitive dust into the system before the dust has a chance to enter the air around the operator and plant environment, reducing housekeeping costs, product loss and risk.

As with most vacuum conveying and support equipment, including pre-engineered systems, bag-dump stations can be modified or enhanced. For instance, if material

BAG-DUMP STATION
Figure 3. Bag-dump station with integrated dust collection and pneumatic LoadLifter allows easy placement of heavy bags on the grate with screw discharger introducing product to the conveying line.

is not free-flowing, then a screw discharger may be added to the bag-dump station to help move the material into the conveying line.

The ability to modify or enhance pre-engineered systems came to fruition when the same toll blender needed a solution for a new customer's blended product that seemed impossible to convey into bulk bags. The solution to getting the clay-like material to convey into bulk bags was a system that included fitting a pickup hopper into the space where fiber bins normally sat.

The pickup hopper was equipped with a free-flowing screw discharger designed to handle sticky powders. From the hopper,

the material was metered into the conveying line that led to a vacuum receiver, where it was discharged into a bulk bag loading station and then released into a fresh bulk bag.

ADAPTING EQUIPMENT TO BUSINESS NEEDS

Challenging powders sometimes need custom solutions, but even when powders behave well with systems, the necessity to customize pre-engineered vacuum conveying systems can arise from growth and automation needs.

When steady growth at a thermal spray coating manufacturer necessitated moving to a large-scale mixer to stay ahead of orders, the company needed to find a way to load six 160-lb barrels into a blender 6 or 7 ft off the ground. After years of loading small 160-lb batches into a 55-gal rotary drum mixer manually, the manufacturer knew that the new system had to be automated.

After researching automated systems of material delivery to blenders, the coating manufacturer chose a pre-engineered direct-charge blender loader. In addition to loading the blender, the spray coating manufacturer also wanted a conveying system to transfer finished product from the blender into boxes all while staying within a specific budget.

Rather than purchasing two vacuum conveying systems — one to convey material into the blender and another to move blended material from the blender into packages — a dual-purpose system was proposed. This dual-purpose system, like the one shown in Figure 4, would use the same conveyor system to load and unload the blender.

After materials were blended, the same vacuum conveying system used to load the blender was connected to the bottom of the blender, and the material was metered by volume into a collection hopper. When the hopper reached a predetermined level, the system stopped conveying and dumped the material into a box.

VACUUM-CONVEYING SYSTEMS

Figure 4. ColumnLift vacuum conveying systems provide vacuum transfer by drawing material directly from floor-level while offering a minimal footprint, eliminating stair climbing, lifting, scooping and dumping.

LIMITATIONS TO MODIFICATIONS

Because pre-engineered systems come from the DNA of custom-engineered solutions, adaptations can be made to fit the unique needs of manufacturers and processors. However, sometimes pre-engineered systems don't stretch into areas in which more technical expertise and experience are required, such as facility constraints. While pneumatic conveying systems have a small footprint compared to other material-handling methods, even the smallest conveying system needs at least 30 in. of headroom above processing or packaging equipment.

In situations in which headroom is not adequate for pre-engineered vacuum conveying systems, positive pressure systems, cyclones, filterless material receivers or scaling valves that divert material directly into hoppers in low-clearance areas can be used to get around headroom constraints. When companies have severe height restrictions, vacuum receivers sometimes are located outside. When possible, adaptations can be made to conveying equipment, such as modifying filter lids, to enable systems to fit within a specific space.

Every vacuum conveying system design, whether it's a sophisticated custom-engineered system or pre-engineered packaged system, begins with a blank page because each organization and plant have unique requirements. Consulting with a vacuum conveyor expert early in the buying process ensures that manufacturers and processors will reap the long lifespan and many benefits of vacuum conveying systems, including maintenance efficiency, which begins at the design stage.

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