PowderBulkSolids.com

JANUARY 2016

Vol. 34, No. 1

POWDER & BULK SOLIDS

The Source for Dry Processing and Bulk Handling Technology

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A significant challenge for pneumatic conveying is that one cannot see what is going on in the pipeline. This makes troubleshooting systems particularly challenging.

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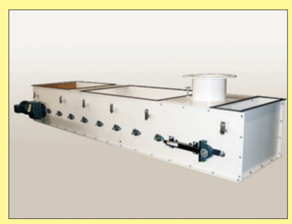
Reverse Acting Rupture Disc

Building on its KUB rupture disc technology, REMBE now specializes in laser-sublimation and IP technology. Both of these processes provide the foundation for the advanced IKB reverse acting bursting disc. Based on sublimation technology, material transition from a solid to gaseous condition, the opening characteristics and the relief area of the IKB bursting disc are pre-defined. The rupture disc's material characteristics and its microstructural properties are not altered and the IKB does not fragment. Through the patented IP process, kinetic energy is "stored" in the IKB rupture disc. When the burst pressure is reached, IKB transforms this energy and instantaneously gives full bore opening as the energy is released.

REMBE Inc., Charlotte, NC 704-716-7022 www.rembe.us

Volumetric Belt Feeder



Designed for highly accurate +/-1 to 1½% metering of all types of powders, pellets, and agglomerates, the new APB volumetric belt feeder is well suited for feeding of abrasive or friable materials and materials that have a tendency to smear or compress when being fed by a volumetric source feeder. It is also ideal for the high-volume requirements of the chemical and food industries. Available in 12-, 24-, 36-, or 48-in. belt widths and 36-, 72-, 108-, and 144-in. lengths (extended lengths available), the APB features a ruggedly built, sliding belt assembly and offers feed rates up to 5800 cu ft/hr. Standard belt material is neoprene and Hycar, Nordel, and Viton are also available.

Metalfab Inc., Vernon, NJ 800-764-2999 www.metalfabinc.com

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UBM

10 Considerations for Pneumatic Conveying System Design

By Doan Pendleton, Vac-U-Max

Food processors are experts at producing food products, chemical manufacturers are experts at developing chemicals, pharmaceutical companies are experts at making drugs, and pneumatic conveying manufacturers are experts at moving bulk solids. Just as it is not necessary to become an expert on how to build a vehicle when purchasing one, it is also not necessary for users of pneumatic conveyors to become experts at vacuum conveying to incorporate them into their processing line. While it is a good idea to have a broad understanding of how pneumatic conveying systems work, no pneumatic conveyor manufacturer will ever ask a customer if they need a dense phase or a dilute phase system. There are, however, many other questions a conveyor manufacturer will ask about a process, and the materials used in that process, that will aid them in designing a system with the necessary components to provide a solution that integrates into a customer's process.

These 300-cu-ft material receivers are part of a pneumatic conveying system that transfers powders in a large-scale candy making process.

Material Bulk Density

The bulk density of a material is one of the first indicators of design in terms of sizing various system components such as vacuum receivers and air sources. Bulk density helps determine how many cubic feet per minute (CFM) of air is needed to move the material through the convey line. Generally speaking, materials with bulk densities below 55 lb/cu ft but above 25 lb/cu ft are fairly easy to convey, while heavier materials require more power and larger vacuum receivers. Fine powders with low bulk density, such as fumed silica, present their own set of challenges and may require more filtration and therefore larger vacuum receivers than medium density powders.

Conveying Distance

Bulk density, while one of the most important factors in sizing a system, is not the sole criterion used to determine components. Another important factor in sizing and determining the type of system needed to convey bulk solids is the distance material is traveling. In pneumatic conveying the more tubing you put in the system, or the further the conveying distance, the bigger your vacuum pump gets because it takes more airflow to pull (or push) the air through the tube.

In dilute phase systems (material entrained in the airflow) when powder must travel more than 300 ft, the system would use positive pressure to push the material in the tube, rather than using vacuum, as a more economical solution

One of the advantages of pneumatic conveying is that moving products vertically is calculated the same as moving them horizontally--in linear feet. However, each 90-degree sweep in the system equals 20 linear feet; thus if you are moving material horizontally 110 ft and vertically 110 ft with four 90-degree sweeps, then the conveying distance is 300 ft.

Convey Rate and Batch Conveying

In addition to bulk density and distance determining the size and type of the conveying system, the rate of material moving through the system is an important factor considered when designing a system, as well as whether the process is a continuous or a batching operation.

While most pneumatic conveyor operations work via cycles of convey and discharge, a batching operation works differently and can have a considerable effect on the size of the system. An example of this would be when a processor wants to move 5000 lb of powder per hour into a mixer, but needs to move the batch into the mixer within 15 minutes. Although the 5000 pounds cycles only once per hour, because the rate of transfer is higher during that 15 minutes, it is actually moving at 20,000 lb/hr, thus, requiring a more powerful vacuum source.

Dilute phase pneumatic conveying systems can transfer up to 25,000 lb/hr via vacuum. For higher rates, a positive pressure source replaces the vacuum pump.

Vac-U-Max MDL105017 sanitary vacuum receiver for fine powders and granules conveys up to 4000 lb/hr.

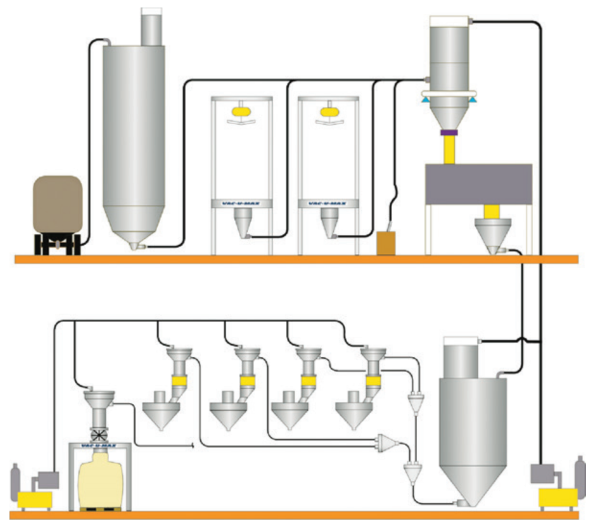
Material Characteristics

Beyond a material's bulk density, an understanding of how a particular substance will behave under certain conditions is essential when designing a vacuum transfer system. Most often customers know whether their particular material is free flowing, sluggish, or non-free flowing and this is important data to relay to the conveyor manufacturer. It is not uncommon for there to be several product grades within the same product group and each one behaves differently than the other. One grade of zinc oxide may have the consistency of talc, while another might be more cohesive and adhere to inside surfaces of conveying tubes. Some materials, in fact, can behave differently from one day to the next, affected by environmental elements.

According to the National Fire Protection Association (NFPA), the preferred technology for handling combustible dust is vacuum conveying. If a leak occurs in a vacuum conveying system, the leak will be inward and prevent dust clouds in the plant environment. A leak in a pressure conveying system will quickly result in a dust cloud in the plant, a primary element for a combustible dust explosion.

To protect delicate or friable materials from degradation, dense phase conveying (where material slugs along in the line en-masse) may be the method used to transfer materials. Dense phase conveying is also useful in situations where processors need to minimize the chance of separation of blended materials.

On average, non-free flowing powders require the most equipment modifications. There is a plethora of methods used to handle non-free flowing powders that can eliminate the need for external flow promotion such as specialized finishes, over-sized receiver discharge openings, 70-degree discharge cones and proprietary designed cone-less (straight-walled) vacuum receivers.



Conveyor manufacturers need to know as much as possible about materials and processes in order to provide precise solutions that integrate into a customer's process.

An example of equipment modification to handle non-free-flowing powders is when Cordele, GA-based Helena Industries experienced increased demand on a particular product line.

The company, which uses a broad range of process technologies to manufacture, formulate, and package herbicides, fungicides, and insecticides, attempted a number of methods in-house to eliminate the need for workers to manually dump 20-40 drums of powder chemicals, weighing up to 225 lb each, from a raised platform.

When none of those methods--including utilizing bucket elevators--produced the desired outcome, the company decided to purchase a pneumatic conveyor to move several hundred pounds of material up a level, in 30 minutes, to a volumetric feeder.

In the test lab, the claylike material proved to be only semi-free flowing, causing bridging and rat holing in the material receiver. To eradicate the issue, a proprietary straight walled vacuum receiver with a full opening discharge valve replaced the standard receiver ensuring quick refill to the feeder below.

In addition, the vacuum receiver was equipped with a specialized multi-filter with pleated filter media that facilitated maximum filtration of the system.

Vac-U-Max pulse dome filter covers above vacuum receivers equipped with side access doors

The system eliminated the ergonomic issue, made it a single person job and minimized environmental dust.

Material Container and Pickup Point

Once material is in the conveying line--whether it's free flowing or not--it usually conveys without issue, but sometimes getting material into the conveying line can be problematic. Therefore, the conveyor manufacturer needs to know what type of container holds the material because it dictates whether the pickup point (where product enters the conveying system) is a wand, a bagging station, a bulk bag unloader, a docking station, or a pick up adapter.

The pickup point is perhaps the most customized component in a pneumatic conveying system because it is crucial for feeding material into the conveying system.

An instance where a pickup point needed customization is at the Tyco Thermal Controls Redwood City, CA facility that produces heater cable using large twin-screw compounding extruders.

An integral part in that manufacturing process is transporting polymers and other powders from supplied containers into the compounding extruder. Due to the very dense, sticky characteristics of the exotic powders, the seemingly simple process of transferring materials presented its own set of challenges.

Here the problem was not getting the sticky material to convey, but getting it to automatically feed into the conveying tube. After several failed trials to get the material into the convey line, the solution was to incorporate aspects of a previous application of handling powdered sour cream. Although the makeup of materials is completely different, the characteristics were similar and that knowledge led to the resolution.

Vac-U-Max filter separator for carbon black

Custom-designed bag dump stations, that were essentially vibrating bins, merged the design of a bag dump station and bulk bag unloader into one unit that allowed the material to flow into the pickup point. The design also gave the cable manufacturer the option of unloading super sacks or 50-lb bags using the same piece of equipment.

Process Equipment

Upstream equipment affects downstream equipment and the more a pneumatic conveyor manufacturer knows about the process the better able it is to supply a system that meets a customer's needs. Conveyor design can change based on the type of process equipment being fed such as loss-in-weight feeders, volumetric feeders, mixers, extruders, packaging and other equipment. For example, loss in weight (LIW) feeders require quick refill. Knowing that the equipment is loading into a LIW feeder influences the design of the system.


With a direct charge blender loader pneumatic conveyor, blenders or mixers function as the primary material receiver and are offered either as floor-standing or suspended units.

When Pacon Manufacturing had a goal to develop a facial care product and also develop a process that maintained quality at the necessary price point, it required high speed conveying and dispensing of its blended powder into packaging machinery.

In this application, how the powder conveyed to the auger fillers critically affected the powder's self-lathering properties. If the powder particles became too small, the product would lather too fast upon use. If the particles became too large, the lathering process took too long. Changing the density, component blend, and texture would produce inconsistent fill rates or volumes -- both unacceptable for quality control.

Since powder can change density in auger filler heads, leading to improper fills, keeping the heads full and at proper density was critical. To maintain proper powder density in the auger filler heads, standard equipment required customization to maintain product quality.

The custom system utilizes two low-profile drum dump stations for easy loading where material travels, by vacuum, to customized filter receivers mounted above three auger fillers. The customization of filter receivers includes a special high polish finish and customized multi-filters.

In addition, a device checks powder levels at each of the three auger filler hoppers. When auger fillers require more powder, predetermined volumes of powder automatically dispense to fill the hoppers.

Designed for simplicity and easy maintenance, the modular convey system has a specially designed receiver for quick toolless assembly/disassembly and easy cleaning. Fabricated with no crevices and the fewest possible welds, the drum dump stations interior bends and corner welds have a minimum 1/8-in. radius to minimize material accumulation. A line clearing valve purges the conveyor system at the end of each convey cycle to prevent fallback powder and make restarts easier.

Vac-U-Max sanitary, batch weigh vacuum receiver

Headroom

Customizing equipment isn't always focalized on materials. Sometimes facility constraints are the reason for equipment modifications. One of the benefits of pneumatic conveying systems is the small footprint compared to other material handling methods, but even the smallest conveying system needs at least 30 in. of headroom above processing or packaging equipment.

Positive pressure systems are one way to get around headroom constraints as are cyclones, filterless material receivers, or scaling valves that divert material directly into hoppers in low clearance areas.

Nutriom, natural powdered egg producer of Ova Easy and Egg Crystals, had a lot of height restrictions because the building is older and has many areas with low ceilings.

The company wanted to replace their food-grade screw conveyor that required expensive H1 lubricants and extensive maintenance with a more hygienic fully enclosed pneumatic system that protects materials from air, dirt, and waste.

When companies have severe height restrictions, vacuum receivers are sometimes located outside. When possible, modifications to conveying equipment enable it to fit within the space.

In this case, filter lids required modification to fit the tight spaces and a venturi, powered by compressed air, was used to generate vacuum. In areas where ceiling height was not an issue, electric-motor-powered vacuum pumps were utilized.

Because the enclosed system was cleaner than the open system, it made compliance with FSIS USDA regulations simpler.

To further accommodate the company's stringent standards and to fit better within its inspection system, stainless steel rings replaced the iron rings that secured the filter.

Plant Site and Industry Environment

In addition to knowing material characteristics, flow rates, and downstream equipment processes, conveyor manufacturers also need to know the geographic location of the plant, as well as the type of industrial environment the equipment will be located when designing a system.

Just as cooking at higher elevation requires alterations, altitude also affects vacuum source sizing. For instance, a factory at the Jersey shore (sea level) might use a 5-HP vacuum pump for an application, but the same application in Denver (one-mile above sea level), where air density is lower, will require a 7.5-HP vacuum pump.

Components in pneumatic conveying systems, like the vacuum pump above or the stainless rings mentioned earlier are interchangeable--and sometimes the difference between two systems with the same design is the material from which the components are constructed.

Conveyor manufacturers must know whether the system requires sanitary design, using 316L stainless steel, or if 304 stainless steel or carbon steel will suffice.

In pneumatic conveying systems, all equipment must complement each other. If one piece of equipment is too large or too small, it will keep the system from working properly. Vacuum receivers must be able to handle the airflow provided by the vacuum source, and balancing the air-to-cloth ratio of filters must occur so filters don't shred or bind. If material can't get into the convey line, there is nothing to convey.

These 10 factors provide crucial information that allows conveyor manufacturers to evaluate applications and customize equipment so their customers can focus on making their products and not on material transfer.

Doan Pendleton, vice president, Vac-U-Max, is an expert in vacuum technology with over 25 years of experience designing and engineering vacuum conveying systems and industrial vacuum cleaners. For more information on Vac-U-max, visit www.vac-u-max.com.

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