VAC-U-MAX

CASE HISTORY

Key Components of Pneumatically Conveying Difficult Materials

Fine tuned flow promotion devices, suitable filters and filter placement, as well as vacuum receiver design ensure peak performance in a system.

Most people are familiar with how vacuum systems work because most have used some sort of vacuum system to clean their homes—put a pipe here, put a pipe there, suck it up and get on with the day. Because of this familiarity, there is a common misconception that designing a vacuum conveying system is a matter of just connecting some components together. While it is true that pneumatic conveying systems are simple in terms of their design, there is a world of difference between transferring bulk materials and sucking up dust from the living room floor; and, there is a distinct difference between conveying relatively unproblematic materials, such as plastic pellets or rice, and challenging powders **s**uch as iron oxide, zinc oxide, calcium carbonate, or toner.

When it comes to pneumatically conveying difficult powders, the difficulty does not lie so much with the conveying of materials through the material line because, generally speaking, once material is entrained in the line it is fluidized and moves freely. Occasionally there are problems in the tube, even with free flowing materials. When difficult material, Titanium Dioxide for instance, builds up in the line, agitator devices easily break materials free.

The primary challenge with conveying difficult powder is more commonly getting material to feed at a constant rate into the material line from the pick-up point and then again getting powder to discharge from the material receiver.

For materials with poor flow properties that don't want to move, extra attention is focused on specially devised flow promotion devices, suitable filters and filter placement, and vacuum receiver design. Proper vacuum pump selection is critical in any pneumatic conveying solution, and therefore does not necessarily stand out in this particular discussion of special equipment needed for difficult powders.

Much like tuning a carburetor on a high performance race car, science can only go so far before testing and fine tuning are needed to bring about peak performance. Designing and testing pneumatic conveying systems is much the same. Even with 60 years of conveyor design experience, application knowledge, and two seemingly identical materials, testing is a necessary step to ensure the system will work as promised when installed in the client's facility. Pneumatic conveying manufacturers should always provide testing with user's material at no charge.

Cohesive and lightweight powders are prone to sticking and can cause choking and bridging. Steady product flow into the material line and a proper solids to air ratio are critical with sticky materials. If the solids to air ratio is too high, the line will plug and if it is too low, you are just sucking air and not transporting much material. Feed devices assist getting material into the line at a constant rate.

Feed Devices

The pick-up point is where material feeds into the tubing network that leads to the vacuum receiver. The pick-up point could be a bulk bag unloader, bag dump station or wand that an operator inserts into a drum. With difficult powders, specially designed flow promotion devices feed devices regulate flow. These devices are most often some type of vibratory device but rotary or screw feeders are sometimes used where applicable.

Zinc Oxide and Iron Oxide are particularly nasty materials to convey due to their very poor flow properties—one could even liken them to conveying mud. In one application, Iron Oxide was being transferred from 50 lb bags using a bag dump station to a mixer reactor. With a bag dump station the operator places a bag on the shelf of the station, cuts the bag open, and the powder falls into collection hopper where it is vacuumed from the bottom of the collection hopper into the conveying line. In this particular application the flow properties of the material was so bad that the material didn’t want to move from there. To get product into the line, a specially devised live bin agitator, a hopper on rubber isolators with an oscillating vibrator that shakes the bin, facilitated material flow into a pick up adapter into the airflow stream.

In addition, the bag dump station includes a unit that draws outside air inward to prevent dust from entering the environment around the operator. In this case, the filters within that unit had to be suitable for zinc oxide. Improper filters can become coated with dust, hindering airflow and choke the machine.

Filters

The material of the filter, the number of filters, placement and cleaning cycle is extremely important for difficult materials. At the top of the material receiver housing, filters separate the product from the clean air traveling back to the vacuum producer. With ultra fine powders, filters can clog and choke the entire conveying process.

Carbon Black is an ultra fine powder, so fine that the running joke is that it gets into the wrinkles of your wrinkles. In one application the task was recover residual Carbon Black out of the bottom of rail cars and discharge it into super sacks. However, during the discharge cycle only 2-3 lbs would drop into the super sacks. After testing with flow promotion, vibration and various other tricks of the trade, it was discovered that the material was getting hung up between the filter socks even with the automatic pulse filter cleaning. The solution was to supply a new filter plate with fewer filters, but just as much filter area, to prevent the material from hanging up between the filters.

For applications where there is not enough space above the receiver, such as direct charge loader blending or low clearance areas, vacuum receivers without filters are available and the filters placed further down the line a safe distance from the vacuum pump.

Receiver Design

Angular surfaces provide areas where difficult materials can bridge or hang up. Supplying a straight walled vacuum receiver eliminates sloped surfaces allowing positive discharge without requiring auxiliary vibration or agitation. The straight wall configuration terminates in an automatic discharge valve the same size as the tube, permitting rapid passage of even the most difficult to handle non-free flowing material.

Ultimately, after all the science and spreadsheets, peak performance when pneumatically conveying difficult powders comes from fine tuning with a client's material and knowing which components will move the material most gently, reducing wear and degradation.

Celebrating its 60th year designing and manufacturing innovative pneumatic conveyor systems and support equipment for the conveying, weighing, and batching of dry materials, Belleville, NJ-based VAC-U-MAX is a pioneer with many industry firsts including air-powered venturi power units, direct-loading of vacuum-tolerant process equipment, and vertical-wall Tube Hopper material receivers. The primary technology for conveying is vacuum, but positive pressure pneumatic systems, as well as mechanical conveyors, are also used as the specific applications dictate. An equally important activity is the design and manufacture of heavy-duty industrial vacuum cleaners, which range from small air- and electric-powered drum-styled units to large electric- and diesel-powered units.

For more information about handling difficult or adhesive materials, or VAC-U-MAX pneumatic material handling or industrial vacuum cleaning solutions, write to them at 69 William Street, Belleville, NJ 07109; call 1-800-VAC-U-MAX (800) 822-8629 or (973) 759-4600; e-mail info@vac-u-max.com; or visit their website www.vac-u-max.com.