New Technology Spotlight…

The Vital Role of Pneumatic Conveying of Aluminum Scrap in Manufacturing

As aluminum is punched and pressed into components used in vehicles and other applications, the process produces a valuable by-product, unused scrap aluminum. In industries such as automobile manufacturing that material can represent 40% or more of the original, making recycling an extremely important component in controlling the overall cost of the material flow process. To increase its value, the scrap must be segregated by alloy (normally 5000 or 6000 series) and then reduced in size for ease of transport on conveyors within a facility and to maximize the density in the trailers hauling the material between facilities.

Aluminum scrap is conveyed within the manufacturing or recycling plant in one of two ways—mechanical belt or pneumatic conveyor systems. Quickdraft, based in Canton, OH, has been engineering and manufacturing pneumatic conveying systems for metals industries since the early 1960s. The company has recently developed an all-negative conveying system to move aluminum throughout a facility in an efficient and space saving manner.

Mechanical vs. Pneumatic Conveying

Mechanical belt conveyor systems have long been an industry-wide staple, but require a considerable amount of valuable floor space for both the conveyor and support structure. It requires a separate conveyor at every change in direction and elevation. As a result of the design, belt conveyors have the risk of material tumbling off the belt, particularly at transfer points, creating a maintenance issue. Furthermore, the angle of any vertical lift is restricted by the material's natural tendency to slip on the belt. Depending on the elevation of the lift space, requirements to accommodate an angled conveyor would be significant.

Pneumatic conveying systems are becoming increasingly popular because they fundamentally solve major issues facing mechanical belt conveyors. Using air flow, the scrap material is picked up and transported through enclosed tubes to a discharge point. Pneumatic conveying systems provide unprecedented flexibility in installation, as the ductwork can be placed against walls or ceilings and can be easily routed around existing structures. It is even possible to configure systems to lift materials vertically. By keeping material enclosed throughout the entire transfer route, pneumatic conveying systems eliminate the potential hazard and maintenance issue of loose material within the facility. The design flexibility inherent in these systems allows for a simplified installation that can be incorporated into existing structures and floor plans, while significantly saving floor space. On average, pneumatic conveying systems with 14-18 inch diameter ducts will use 90% less floor space than conventional, mechanical conveying systems (Figure 1). This space saving can be a significant factor in plant operations looking to retrofit or expand their aluminum scrap handling capabilities in an existing facility.

However, many pneumatic conveying systems are of rudimentary design, using fans to generate an air current to move the material through the system. These systems are functional but all contain a fundamental design flaw, since the fans are placed within the material stream, the metal scrap is forced through the fan blades. Any system with fans in the material flow path will result in the material constantly impacting the fan rotor, housing, and shaft—thus necessitating ongoing maintenance and replacement. The production line is therefore vulnerable to unexpected fan failure at any time, shutting down the entire process line. Such system downtime can be critical. For example, for a major U.S.-based auto manufacturer, 18 minutes of downtime every three days would cost them the production of 3,500 vehicles a year. When product demand is high, reliability is paramount for a company to maintain their position as a market leader.

Quickdraft developed the Venturi blower technology (Figure 2) for its pneumatic conveying systems to meet the high performance demands of conveying materials efficiently and reliably. The system utilizes a high pressure blower that is located outside of the material flow stream. The blower forces air through the Venturi plenum, where the Bernoulli principle accelerates it to a higher velocity. Generally, a Quickdraft system only requires one Venturi external blower in a centralized location to generate a powerful enough suction to maintain air velocity and vacuum pressure over long distances. This enables the system to rapidly convey material through the ducts without any obstructions throughout the entire line. Since there are no material impacts on the blower, the pneumatic system is able to provide 24/7 operation and years of reliable trouble free service, with maintenance only consisting of routine lubrication.

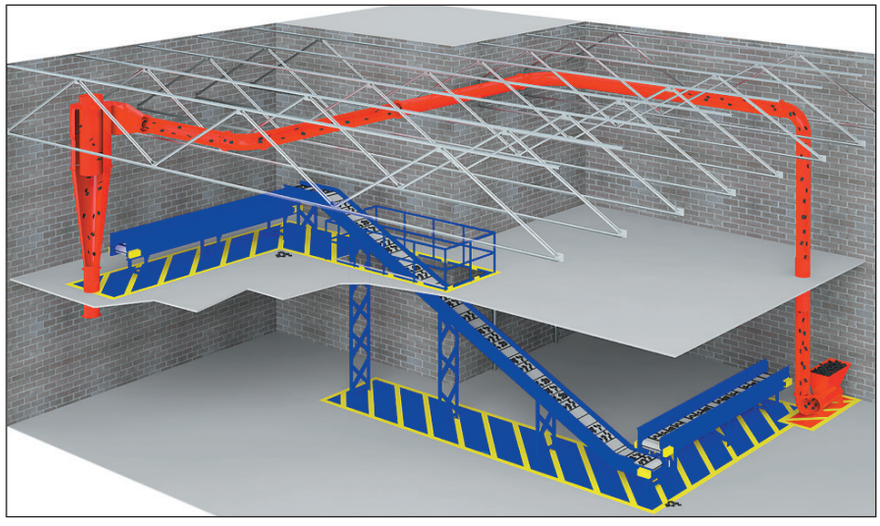

Figure 1. A pneumatic conveying system (shown in red) has the potential to use 90% less floor space than conventional mechanical conveying systems (shown in blue).

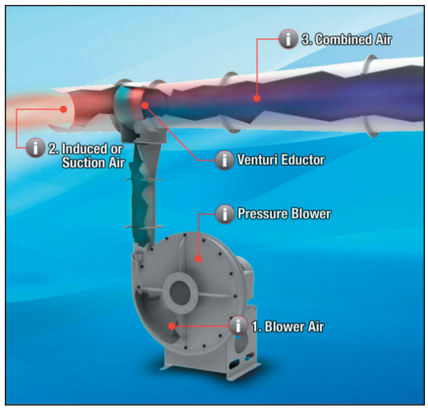

Figure 2. The Venturi blower system externally creates a suction that is sufficiently powerful to rapidly convey the material through the system.

Figure 3. When the material is conveyed to the large separating chamber, air pressure is dropped to allow the material to fall into the chamber below.

All-Negative Conveying System

Quickdraft's most recent innovation in pneumatic conveying is the all-negative aluminum conveying system, which provides the reliability and space saving benefits of the Venturi blower technology while minimizing operating horsepower requirements for energy cost savings. Using one or more blowers (depending on the material size and flow requirements), the system vacuums the material into a large separating chamber (Figure 3), where the air velocity is dramatically reduced. As the material decelerates, it falls out of the conveying air stream into a discharge chute. Meanwhile, the conveying air is pulled from the chamber and exhausted directly to the atmosphere.

The system is able to maintain the necessary vacuum pressure during this process through a series of dampers. While the discharge chute is being filled, the bottom damper is closed. Then, once it is full, the upper damper closes to seal the system, allowing the accumulated material to drop onto a conveyor belt or a trailer or other container.

Quickdraft designs each system to meet the needs of each specific installation in order to maximize the facility's return on recycled material. For example, the all-negative system can also be designed to segregate material grades, either by diverting material into a dedicated separator or discharging from a common separator onto a mechanical conveyor, which shuttles the material into the designated transport trailer or furnace.

The all-negative conveying system was introduced approximately three years ago, with the first installation at a major North American aluminum producer. The system is currently installed in a number of aluminum recycling and vehicle production facilities. The latest all-negative system Quickdraft has engineered, fabricated, and installed is able to move shredded aluminum over 700 ft, the length of two football fields. It conveys over 30,000 lbs/hr (13,600 kg/hr) of shredded aluminum. To date the system has moved approximately 1.4 billion lbs (6.35 million kg) of aluminum, enough recycled material for approximately 280,000 mid-size pickup truck bodies. ■