HARPERLOVE

ADVANCED ADHESIVES REPORT

YOUR CORRUGATING NEWSLETTER FROM HARPERLOVE
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Starch Silos

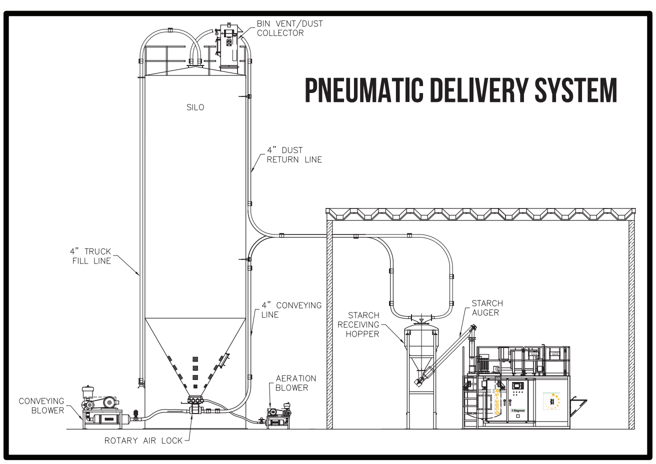
by Peter Snyder

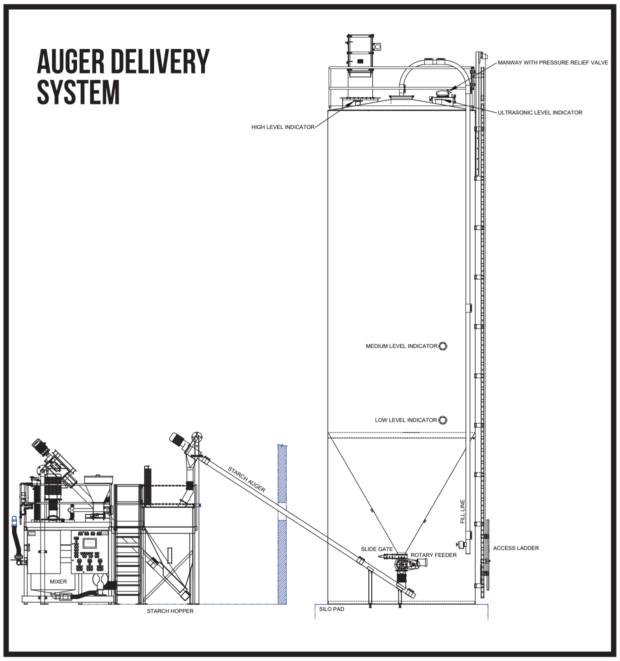
Starch silo systems are designed to store and deliver bulk powdered raw material for manufacturing corrugating adhesive. Silos create a safer, more automated work environment than using bags or sacks of starch. While corrugated plants are primarily in the box business, they are also, although on a much smaller scale, in the business of manufacturing adhesive. They must manufacture consistent batches of starch adhesive several times per shift to successfully produce high-quality corrugated board.

In the early days of the corrugated board business, the scale of starch use was relatively small. Plants made their own adhesive manually, and starch was typically delivered in 100-pound bags. As the scale of the corrugated plants grew, it became difficult for the manual processes to keep pace. This expansion in production ushered in automatic adhesive mixing systems and encouraged the industry's transition from bagged to bulk starch.

Bulk starch is typically delivered in railcar (150,000# - 180,000#) or truckload (~43,000#) quantities. Silos are available in a wide range of sizes and are usually designed to handle the specific needs of each plant and the desired delivery quantity. For the corrugated industry, the capacity range is generally 90,000# - 120,000#. A silo of this size would typically be 10' – 12' in diameter and 30' – 60' tall. In colder climates where winter weather conditions can impact the reliability of deliveries, some plants install larger silos to provide an inventory buffer.

Modern silos are normally constructed from steel, with straight sides leading to a cone shaped outlet at the bottom. They are designed to deliver starch directly to the adhesive mixer via an auger or pneumatic system. An auger feeding system typically requires the silo to be located within





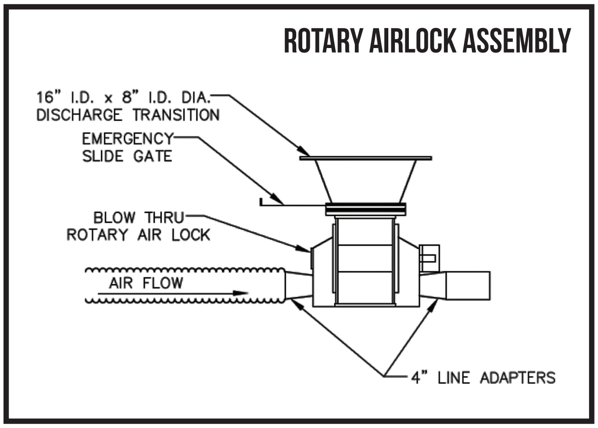
approximately 20' of the mixer. If this is not practical, the silo can be located where there is adequate room on the property, and starch is then delivered to the mixer by a pneumatic delivery system.

Both types of delivery system rely on gravity to pull the starch down to the cone opening in the bottom of the silo. The nature of the powdery starch often requires vibration and air lubrication to keep it moving out of the silo. Air pads and vibration devices are installed onto the silo cone to keep the starch moving quickly and to avoid the creation of air pockets, or cavitation. Improperly maintained air pads or vibration systems can lead to issues getting starch to flow out of the silo.

Auger style delivery systems are designed to allow starch to flow out of the bottom of the silo directly into the sealed auger tubing. The auger tubing has a center shaft with delivery "flighting" attached in a circular pattern. As the shaft turns, the flighting carries the starch forward and delivers it into a receiving hopper or directly into the mixer. There are typically two delivery speeds for the auger. For the smaller carrier starch portion of the batch, the starch is delivered at approximately 20# per minute. For the larger secondary portion, the auger begins at approximately 100# per minute. As the delivered starch quantity approaches the targeted amount, the auger slows to approximately 20# per minute to improve the accuracy of the delivered amount.

Pneumatic starch delivery systems rely on 3" - 4" aluminum tubing and air flow to circulate airborne starch from the silo to the starch room and back to the silo. A pneumatic system can deliver starch over 400' from the silo. As the pneumatic delivery system starts, two air blowers are engaged. The first blower activates the air pads on the bottom of the silo. The second blower provides an air current to convey the starch. This low-pressure air flow is injected into the aluminum tubing at the bottom of the silo below the rotary airlock. The current of air travels through the tubing to the delivery point in the starch room, then returns in continuous tubing to the top of the silo. This loop establishes a circulating current of air flow from the bottom of the silo to the top of the silo.

It is important to note that every bulk silo has a ventilation system installed to allow air, or new loads of corn starch, to flow into the silo without any air pressure buildup. This pressure relief is accomplished by a cloth bag venting system known as a baghouse. The baghouse allows the silo to "breathe" and exhaust filtered clean air. It is important that each silo baghouse system be inspected on a regular basis to ensure that it is working properly. The baghouse may be equipped with a bag shaker system or a pneumatic back-pulse system to reduce clogging, but starch dust can build up and eventually clog the cloth bag filters leading to elevated pressure inside the silo during starch delivery. Be sure to monitor the differential pressure across the bags to know when they are getting too dirty.



Once the stream of air current is established from the blower to the mixer and back to the silo, a rotary airlock on the bottom of the silo starts turning and the corn starch is metered into the air flow.

The air flow carries the corn starch to the starch room where it is delivered to a receiving hopper or directly into the mixer. The receiving hopper is essentially a small storage silo located near the mixer, with a typical capacity of approximately 2000 pounds.

Once the starch requirements of the mixer are fulfilled or the starch receiving hopper is full, the rotary air lock stops the starch feed from the bottom of the silo. The air continues blowing to clean out the delivery and return tubing and flushes the "in-flight" starch back to the silo.

The receiving hopper has an auger system similar to the one described previously which delivers starch to the mixer during the batching process. The receiving hopper is automatically refilled from the silo after starch is delivered to the mixer.

Supplying bulk starch to an adhesive mixing system is a straightforward process managed by sophisticated equipment. It provides much improved safety and efficiency over the manual bag-based systems of the past. To ensure that the bulk system continues to deliver starch safely and reliably, work with your adhesive mixing system supplier and starch supplier to develop a maintenance program to avoid breakdown.

Pin Adhesion Testing

by Freddy Ramsey

Pin adhesion tests can provide great information for corrugator crews to determine if they are using the proper amount of adhesive, but there are also several areas of the corrugator that should be checked to maximize pin adhesion.

It is important to ensure that the paper temperatures are within specification at several critical points on the corrugator. The medium and top liner exiting the pressure roll/pressure belt should be 185°F - 195°F; the top liner and bottom liner entering the nip of the double backer should be in the 190°F range, with the flute tips at a temperature close to the adhesive gel point (142°F - 145°F); the bottom liner exiting the double backer after the shear should be around 200°F - 215°F.

We also want to be sure we are transferring the proper amount of adhesive from the medium to the bottom liner. We can confirm this by a soak test and measuring the glue lines. If we have a 0.080" glue line on the medium flute tips and a 0.040" - 0.045" glue line on the bottom liner, we are only getting a transfer rate of 50-56%. Ideally, we would like to see the transfer rate around 75%, which would lead to a 0.060" glue line on the bottom liner. We can improve the transfer rate through a combination of loosening the tension on the top corrugator belt and running with more hot feet or ballast rolls down in the double backer. The increase in pressure from the ballast rolls and hot feet may overheat the paper (which can be measured after the shear on the bottom liner), so we may need to also reduce the steam pressure to reduce the heat in the plates.

PIN TESTER

When all our target temperatures and glue line widths are within specifications, we can gather our samples for pin adhesion testing. The samples should be allowed to cool to room temperature before conducting the test. Pin tests with a low number (e.g., low 40's) let us know we may not have enough adhesive on the flute tips. We can add adhesive by increasing the glue roll to metering roll gap in 0.001" increments. If we are getting a high pin number (e.g., upper 50's) the adhesive may be reduced by decreasing the gap. The corrugator crews should be able to adjust the temperatures and the glue gaps to find the optimum settings to achieve the target pin adhesion for each board grade and flute type. When they have these settings identified, they should save them in the control system (e.g., Copar, Escada, QDM, Syncro) for future use.

Pin adhesion tests can provide useful insight for optimizing the amount of starch adhesive, but the pin tests should be performed only after ensuring you have the corrugator set up with the proper glue line widths and paper temperatures.

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